

# ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

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# ANNALS *of* SURGERY

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No. 2

## GOITRE \*

A CLINICAL STUDY OF ONE HUNDRED AND THIRTY-NINE CASES

BY MILES F. PORTER, M.D.

OF FORT WAYNE, IND.

THE group of cases forming the basis of this study is made up of those cases only the records of which are on file in my office in the card system which I have been using since November, 1912. This group was chosen because it was believed that it would be thoroughly representative, and especially because of the availability of the records for the purpose of study. No case is considered which presented itself after August 18, 1919. Total number of cases 139—females 121, males 18. This makes the proportion of males to females 1 to 6.7. The preponderance of females, it will be noted, is slightly less than that given by Dock,<sup>1</sup> which is 6 or 8 females to 1 male. It is pretty generally believed, especially since our experience with the draft, that the preponderance of females over males is not so great as it was formerly thought to be. Of the 139 patients, 74 of them presented themselves because of symptoms developing in a heretofore symptomless goitre or because a quiescent goitre had begun enlarging. In 47 of the 81 operative cases in which the history covers this point, the symptoms calling for operation developed on old symptomless goitres. In seventeen cases no mention is made in the histories bearing upon this point.

The youngest patient was 16, the oldest 70, both females. The average age of all patients was 35.5 years, average age of males 33.7 years, average of females 35.8 years. Of the 121 females 82 were married, 39 were single. In other words, 67.7 per cent. of the female goitre patients of this group were married. The statistics show that in Indiana about 65 per cent. of the females between 15 and 50 are, or have been, married. These figures seem to indicate that the marriage state itself is not particularly conducive to the development of goitre. Fifty-nine (72 per cent.) of the married females in this group were parous and eight (9.8 per cent.) sterile. Norris<sup>2</sup> says that one marriage in seven or eight is sterile and that from 50 to 75 per cent. of this sterility is due to the woman. Calculating from the figures given by Norris we find that 90.63 per cent. of married women are fruitful. In this

\* Read before the American Surgical Association, May 4, 1920.

<sup>1</sup> Modern Medicine, p. 837, vol. iv.

<sup>2</sup> Surgery, Gynecology and Obstetrics, 1912, vol. xv, p. 706.

group of cases the percentage of fruitful marriages is 18.63 per cent. less than this, *viz.*, 72 per cent., indicating that goitre may be a causative factor in childless marriages.

Of the 139 cases 99 were treated surgically: Thyroidectomy was done in 81, injections of boiling water in 18 and in 3 cases both forms of treatment were used. In 2 of these the thyroidectomy followed the injection of boiling water and in 1 boiling water was injected into the right lobe at the time the left was removed. In one patient the right lobe was removed some months after the removal of the left by another operator. Of the cases which came to operation there were 10.8 females to 1 male—a somewhat greater preponderance of females than occurs in the same group when operative and non-operative cases are considered together. A very large proportion of the specimens removed by operation were submitted to microscopic examination—perhaps 90 per cent. or more, though I cannot speak with exactitude. No case of so-called metastatic colloid goitre was encountered and I will add that I never have seen one. Five cases were pronounced malignant. All of these patients were females, all were married—four were multipara. One woman had been pregnant once and had aborted herself. Three of the patients presented toxic symptoms—two of them also had exophthalmus and two patients presented no toxic symptoms but came for operation because of pressure symptoms plus the disfigurement. In four of the patients the symptoms which caused them to consult a surgeon developed in a goitre of long standing. In two of these cases only the suspicion of malignancy was entertained prior to the operation either because of the rapidity of growth or the nodular feel of the tumor or both. The average age in these five malignant cases was forty years. The first of these operations was done in July, 1913, and the last in April, 1917. On one I am unable to get any report and the remaining four are living and well, although one of them reports that at times "it seems as though her neck is enlarged," but I have not had the opportunity to examine her. The other three show no signs, local or otherwise, of a return of the trouble and one has passed through a normal delivery since her operation. Balfour<sup>3</sup> gives the cancer incidence in a group of goitre patients from the Mayo Clinic as 1.19 per cent. Ochsner and Thompson<sup>4</sup> say that it is less than 1 per cent. In this group of cases it is 3.64 per cent. Considering the large incidence of malignancy in this group together with the percentage (100) of cures, one is led to question the diagnosis in some, at least, of these cases. It is well to note here, however, that while all of these patients have passed the three-year period, only one has passed the five-year period, while two are within a few months of the end of the five-year period. Microscopic sections on which the diagnosis of malignancy was based are herewith presented, together with the pathologist's diagnoses. (See Figs. 1, 2, 3, 4 and 5 with accompanying legends.) Having presented the evidence I prefer, without further argument, to leave

<sup>3</sup> Collected Papers of the Mayo Clinic, vol. x, 1918, p. 393.

<sup>4</sup> Thyroid and Parathyroid Glands, p. 33.

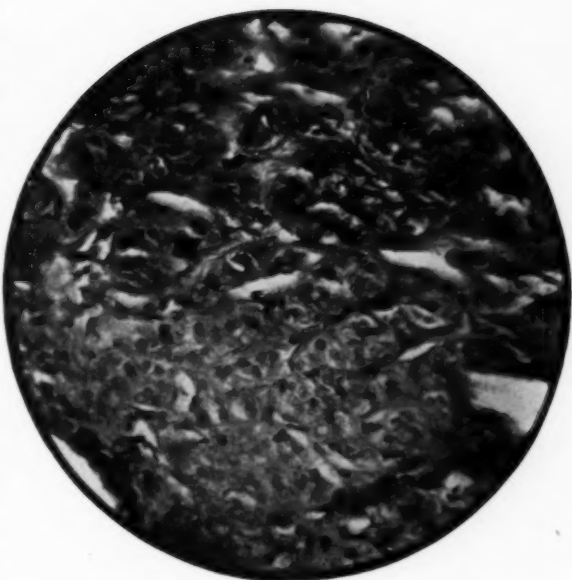


FIG. 1.—Mrs. K., aged thirty-one years. Clinical diagnosis: simple kottre. Pathologist's report: "Old mass shows marked adenomatous growth and little tendency to form gland lumen. It is the type approaching malignancy and in my humble opinion it is malignant." Objective. Signed—B. W. K. Patient cannot be traced.

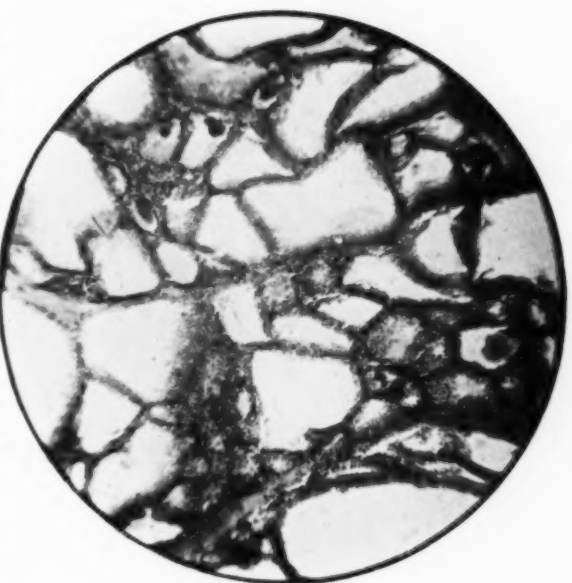


FIG. 2.—Mrs. K., aged thirty-eight years. Clinical diagnosis: Simple kottre. Pathologist's report: "Soft portion of tumor consists of closely packed adenomatous structure with very small lumen and free cellular growth in intercellular tissue. I consider this malignant."—B. W. K. Subjective. Patient's report: "Some pain in throat. Somewhat enlarged." Four years after operation.





FIG. 3.—Mrs. S., aged fifty years. Clinical diagnosis: Exophthalmic toxic goitre. Malignancy suspected because of rapidity of growth and nodulation of tumor. Pathologist's report: "Malignant adenoma—badly broken down. Section from less degenerated portion—*h* objective." Signed—B. W. R.



FIG. 4.—Mrs. S., aged twenty-seven years. Clinical diagnosis: Exophthalmic toxic goitre. Pathologist's report: "Adenocarcinoma—papillomatous outgrowths," *h* objective. Signed—B. W. R.

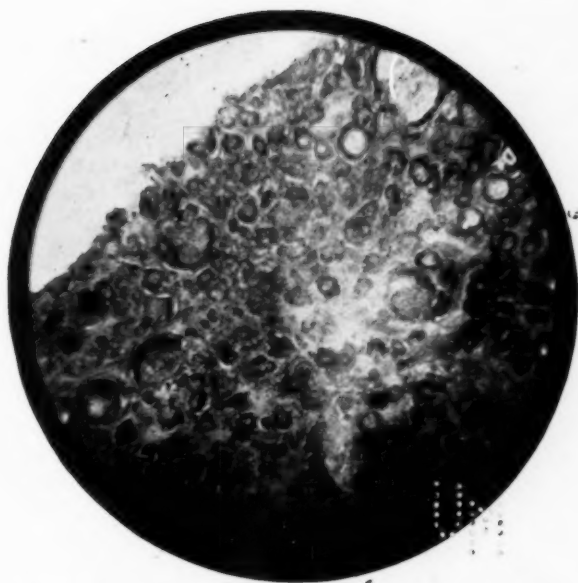


FIG. 5.—Mrs. N., aged fifty-nine years. Clinical diagnosis: Hyperthyroidism with suspicion of malignancy because of recent rapid increase in size of goitre of thirty years standing and the nodular character of the tumor. Pathologist's report: Irregular diffuse growth of epithelial cells which are definitely malignant. These seem to originate from the cells lining the gland acini and are arranged in a rather alveolar form. There is relatively little colloid. The fibrous stroma is abundant in parts and very scant in others. Diagnosis: Carcinoma of thyroid. Signed—B. M. E.

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## GOITRE

the judgment in the case in the hands of fellows who have had a larger experience than I. Simply adding that the microscopic diagnoses in four of the five cases were made by Dr. B. W. Rhamy, of Fort Wayne, who is a pathologist of large experience, and in the remaining case by Dr. B. M. Edlavitch, also of Fort Wayne, and who has had considerable experience.

One patient only of the operative cases presented symptoms of parathyroid trouble after operation. They were very mild and subsided in a couple of days. In two of the thyroidectomies there were symptoms of injury to the recurrent laryngeal nerve. One seems to be permanent, at least she is seldom able to speak above a whisper now more than three years after the operation; in the other case there was partial aphonia, which lasted but a few days. In both the posterior capsule was left at operation and in neither did I have any suspicion that the nerve had been injured until the aphonia was noted. It is important to add that the patient with the permanent aphonia had experienced attacks of loss of voice on several occasions prior to the time she came for operation. I have not been able to trace all of the operative cases and therefore cannot speak with accuracy as to the results, but inasmuch as I asked all of the patients to keep me informed of their progress, and especially to inform me if they did not get as well as they thought they should, and do know positively of the results in the majority, I feel warranted in saying that the operative treatment has been very satisfactory. One patient is still suffering, after thyroidectomy, with toxic symptoms with quite a considerable enlargement of that portion of the right lobe which was left at the time of the operation. One patient who presented a typical picture of the so-called neurotic type was, after extensive study by my confreres and myself, subjected to thyroidectomy for a small goitre which was present. Three months later he reported as having gained 11½ pounds in weight but as being no better so far as nervousness and weakness was concerned. In none of the cases with marked exophthalmus was this symptom entirely cured, but most of these patients declare that their eyes have always been prominent and are satisfied with the degree of retrogression that followed the treatment. There were no operative deaths attributable to the boiling water injections. Two patients whose goitres had been injected died some time after the last injection was given. One with pronounced cardiorenal involvement which had existed for some months prior to her first visit to me. In this case no post-mortem was made. The other patient who died following the boiling water injections had received in all three injections. She presented the usual picture of pronounced thyrotoxicosis including exophthalmus. The patient presented no symptoms of reaction after either of the injections and went to her home town and died four days after the last treatment. Post-mortem examination was made by her attending physician, from whose report the following abstract is made: "Universal enlargement of the mesenteric lymph-nodes. Right kidney much mottled, pyramids very dark, capsule easily stripped, left kidney very hard, not so large and not so much mottled. Spleen enlarged with numerous light

spots hard to the touch, left adrenal large, right not so much enlarged. Heart enlarged, muscular tissue normal. Remains of old lung and pleural lesions. The thymus gland, especially the right lobe, much enlarged—as long as the index finger. Thyroid enlarged, very firm, cuts with difficulty. Colloid material absent. Tissue has the appearance of boiled veal or pork." Urinalysis made in this case, twenty-four days before death occurred, revealed a normal urine. The findings in this case indicate that the cause of the patient's death lay in the pathology found in the thymus and adrenals and raises the question as to the possibility of procuring relief through a thymectomy. At no time when I saw her did I regard her as a safe risk for even so slight an operation as ligation.

One of the patients treated with boiling water injections was in extremis when I saw him, with very aggravated symptoms of thyrotoxicosis, including anorexia, emaciation, diarrhoea and mental aberration partaking of the nature of active maniacal type. After the third injection this patient went to his home town, continued to improve until he was considered a reasonably safe surgical risk, when he had a thyroidectomy at the hands of his home surgeon with results reported to me several weeks later as entirely satisfactory. Several patients who received boiling water injections were advised to have thyroidectomies done later. Five followed this advice, the rest were satisfied with the improvement following the boiling water injections and refused further surgical interference notwithstanding the fact that in several patients the goitre was large enough to be quite unsightly. There were three deaths following thyroidectomy—one death occurring during the operation, one 30 minutes after and one two hours after operation. The anæsthetic used in two of these fatal cases was ether and in one novocain. Post-mortem was not permitted in either case. I know now that operation should not have been attempted in either of these cases. One of the patients had been cured a year before her visit to me by boiling water injections given by her family physician and was very insistent that a radical operation be done if possible, and I allowed myself to be persuaded to remove her goitre under local anæsthesia after twenty days' rest and treatment in the hospital. Of the other two fatal cases neither improved under rest, etc., and I was persuaded to undertake a radical operation when I should have done either a ligation or boiling water injection. There were no fatalities after June, 1916.

In patients who are good risks and who stand thyroidectomy well there is, in my opinion, no objection to doing other operations which are necessary at the same time. I have done hernioplasty, salpingectomy and hemorrhoidectomy immediately following thyroidectomy several times and have had no cause to regret my action. In this group of cases 65 were toxic, 26 exophthalmic, 37 simple, and the remaining 11 were unclassified. The boiling water treatment was given only in toxic and exophthalmic cases. Seventeen thyroidectomies were done for simple goitre. A study of this group of cases throws no light on the question as

## GOITRE

to the relationship between goitre and local infections. Indeed, it is pertinent to say here that my whole goitre experience has left me undecided as to whether or not there is any causal relationship between local infections and goitre except infections of the thyroid itself and infections of the generative organs. There are patients in this group wherein a cure of frequent attacks of tonsillitis followed thyroidectomy and other patients in which removal of the tonsils was followed by a subsidence of the thyroid symptoms and still others in which the thyroid symptoms were not benefited by the removal of the local infection and again others in which the removal of the thyroid had no influence on the local infection present.

In the thyroidectomies local anæsthesia was employed in seven cases, both local and general in two, and in the remaining sixty-seven cases ether was used. Routine blood examinations were not made, for the reason that after quite a number of these examinations had been made the conclusion was reached that nothing of prognostic or diagnostic significance was to be gained thereby. In no case did a reaction of consequence occur and in no case was there alarming hemorrhage at the time of operation. In two patients, both young females, troublesome hemorrhage occurred a few hours after the operation. In one the hemorrhage was brisk and required a tampon, which was removed after forty-eight hours, after which the case progressed normally. In the other case the hemorrhage partook more of the nature of an oozing which kept up for forty-eight hours and in spite of what seemed an ample drain of rolled rubber dam a hæmatoma was formed and was followed by a low grade infection which prolonged the recovery several days. Stimulating treatment following operation was seldom used, perhaps in five or six cases all told.



## ADENOMA WITH HYPER THYROIDISM \*

BY CHARLES H. MAYO, M.D.

OF ROCHESTER, MINN.

THE report from the Surgeon General's Office of the physical condition of the first million draft recruits made us appreciate the fact that we have actual goitre regions in America. Goitre is most prevalent in the northwest states and next in the Great Lakes region; in some of the southern states and in the New England states the disease is rare.

I first operated for goitre in 1888 and I wish to express my appreciation here of the teaching of that great master surgeon, the late Theodor Kocher, who called special attention to the avoidable complications in surgery of the thyroid. Before Kocher's death approximately 5000 operations had been performed for goitre at his clinic.<sup>16</sup> Reports show that there are variations in the changes in the thyroid in different countries; thus cancer and simple goitre were proportionately much more common in Kocher's reports than in those of this country. It was only after 1900 that Kocher strongly advocated surgical treatment of exophthalmic goitre.<sup>14</sup> The condition shown by Plummer to be adenoma with hyperthyroidism had been described in foreign clinics as atypical exophthalmic goitre and was classified by various authorities into more or less ill-defined groups, designated as secondary morbus basedow (Gauthier and Buschan), formes frustes, or incomplete (Marie<sup>20</sup>) goitre heart (Kraus, Gittermann, and Stern), sympathicotonic and vagotonic (Eppinger and Hess), goitre basedowifié (Marie<sup>21</sup>), and basedowized (Kocher<sup>13</sup>). These groups include psychoneurosis, early exophthalmic goitre, and hyperthyroidism from adenoma. Gittermann more nearly than the others describes the symptoms, but he attributes the condition to a cardiac cause and recommends cardiac therapy in contradistinction to the preëxisting theory that the cause of exophthalmic goitre is to be found in the central nervous system. Adenomas with hyperthyroidism had not been definitely enough described to be commonly recognized since they were considered an atypical type. No pathologic findings other than those noted in adenoma without hyperthyroidism have been found to characterize adenoma with hyperthyroidism; the latter contains areas of varying degrees of degeneration and sometimes scattered areas of hypertrophy, but similar areas are also found in the non-toxic adenomas.

Plummer has had an opportunity to observe in the clinic not only the majority of cases of adenoma with hyperthyroidism and of exophthalmic goitre, but also several thousand cases of adolescent goitre and simple goitre in which operation was not advised. As a result of his clinical observation the present standardization of goitre has largely come about.

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\* Read before the American Surgical Association, May 4, 1920.

## ADENOMA WITH HYPERTHYROIDISM

In 1906 Plummer noted that from 17 to 20 per cent. of the patients whose condition was clinically diagnosed at that time exophthalmic goitre had atypical symptoms; goitre, loss of weight, tachycardia, nervousness, and tremor were present without exophthalmos. These cases of adenoma with hyperthyroidism were discussed by Plummer at the meetings of the American Medical Association in 1911 and in 1912.<sup>24</sup>

About a century and a half ago exophthalmic goitre was described as a clinical entity by Parry, long afterwards by Graves, and later by Basedow. Möbius, in 1887, suggested that in exophthalmic goitre the gland is probably over-active in secretion, and Greenfield, in 1893, observed that diffuse parenchymatous hypertrophy and hyperplasia are present and that the gland contains little colloid. Wilson, in 1908, confirmed and elaborated Möbius' theory by the publication of a report on the first large series (294 cases) studied; he also showed that in a certain percentage of cases clinically called exophthalmic goitre the glands did not show diffuse parenchymatous hypertrophy and hyperplasia on microscopic examination. MacCallum, in 1905, was content to place such cases in the hyperplastic class if a small amount of hyperplasia was found. Kocher did the same in 1912.<sup>15</sup> It should be stated that there is a small percentage of cases, an intermediate group, between exophthalmic goitre and thyrotoxic adenoma which leans to one or the other condition, hyperplasia with adenoma or small adenomas with areas of hyperplasia.

Up to January, 1920, the surgeons of our clinic performed 9613 operations for simple goitre, including adenoma with hyperthyroidism; 10,135 operations have been performed for exophthalmic goitre during the same period. Previous to 1912 adenomas with hyperthyroidism were included with exophthalmic goitre. Many of the patients with exophthalmic goitre had more than one operation, such as ligation, before resection.

The services of Kendall, a trained biochemist, were secured and a laboratory was opened in the clinic for the study of the chemical nature of the gland. In December, 1914, the active principle of the thyroid gland, thyroxin, was first isolated by the use of barium salts, and three years later a small amount of thyroxin was synthesized. The synthesis was repeated and the structural formula confirmed in April, 1919.

Plummer, in 1916, presented his theory that the thyroid secretion is active in metabolism and that it vitally concerns the available energy of the cell,<sup>28</sup> and during this year he started a metabolism laboratory with Doctor Boothby and Miss Sandiford, of Boston, in charge. All varieties of goitres, including those with related complicating diseases, were studied. The basal metabolic rates in the patients with myxœdema were especially helpful; by giving definite amounts of thyroxin intravenously or by mouth it was possible to bring their basal metabolic rates to normal within given periods, and by continuing the tests the rapidity with which the thyroxin is exhausted was shown. The amount burned daily, the amount in the gland, and the amount in the body of the normal person

were soon determined. Previous observers, Magnus-Levy and others, have pointed out the excessive oxidation shown by metabolism in cases of hyperthyroidism, but no one had been able to state the degree. Plummer was enabled to determine the degree in exophthalmic goitre above the basal metabolism and to standardize the disease in appearance, severity, and activity, thus standardizing also the degree of thyroid deficiency in myxœdema.

✓ Plummer in his various communications since 1909 has shown that the condition of hyperthyroidism may occur in adenoma without diffuse parenchymatous hypertrophy and hyperplasia;<sup>25</sup> this was supported by ✓ Goetsch in 1916, who called attention to the marked increase over normal in mitochondria in the thyroid gland in cases of exophthalmic goitre and of toxic adenoma. Bensley has shown the granules to be numerous in the thyroid cells, and others have shown that they are increased in number in the active or growing cells in general, whether representing work activity or proliferative activity is not determined.

✓ The essential points in the clinical differentiation of exophthalmic goitre and adenoma with hyperthyroidism presented by Plummer in 1913 are:<sup>26</sup> (1) The difference in the average ages of the patients when the goitres were first noticed. Enlargement of the thyroid was noted from five to ten years earlier in life by the patients with non-hyperplastic goitre than by the patients with hyperplastic (exophthalmic) goitre; (2) the time elapsing between the appearance of the goitre and the onset of hyperthyroid symptoms; in cases of exophthalmic goitre the symptoms of hyperthyroidism followed the appearance of the goitre within an average of nine-tenths of a year, while in cases of non-hyperplastic adenoma with hyperthyroidism an average of fourteen and one-half years elapsed before the symptoms of hyperthyroidism appeared; and (3) the relative frequency of exophthalmos in exophthalmic goitre contrasted with its almost absence in non-hyperplastic adenomas with hyperthyroidism.

Exophthalmos occurs within three months of the appearance of hyperthyroidism in an average of 50 per cent. of the cases of exophthalmic goitre and within two years in 87 per cent. Exophthalmos, even of questionable degree, was rarely noted in cases of non-hyperplastic adenoma with hyperthyroidism. In 1915 Plummer published a brief résumé of an immense mass of evidence to show the differences in the average blood-pressure in these two syndromes and the definite tendency to hypertension in adenoma with hyperthyroidism, which is not found in exophthalmic goitre.<sup>27</sup> The marked differences in the clinical pictures of exophthalmic goitre and of non-hyperplastic adenoma with hyperthyroidism led Plummer, in 1916, to point out, in an extremely valuable article, the probability of the different etiology in the two diseases; he had previously given the working hypothesis: "The active agent of the thyroid gland is a catalyst which accelerates the rate of formation of a quantum of potential energy in the cells of the organism." In May, 1916, Plummer



# ADENOMA WITH HYPERTHYROIDISM

TABLE I.  
Average Metabolic Rate and Blood Pressure in Adenoma and Exophthalmic Goitre Before and After Treatment<sup>1</sup>

	Adenoma		Exophthalmic goitre		
	Without hyperthyroidism	With hyperthyroidism	Two ligations, 2 months' rest and thyroidectomy	One ligation and thyroidectomy	Thyroidectomy
Number of cases averaged in each group	167	18	36	52	52
Age, years	43.8	16.9	35.0	36.7	33
Duration of goitre, years	16.9	17.9	2.8 (1.6) <sup>2</sup>	3.0 (1.0)	3.2 (1.4)
Age at onset of goitre, years	26.9	29.8	32.2 (33.4)	33.7 (35.7)	29.8 (31.6)
Duration of symptoms, years	2.0	2.2	1.6 (1.3)	1.4 (1.0)	1.3 (1.0)
Age at onset of symptoms, years	45.7	45.2	33.4 (33.7)	35.3 (35.7)	31.7 (32.0)
Systolic B. P.	143	156	147	148	142
Diastolic B. P.	85	86	73	75	78
Pulse pressure	58	70	74	73	64
Pulse rate	91	102	126	124	121
Hemoglobin	75	73	70	71	74
B. M. R.	+2	-4 -8	+66 +50 +42 +19	+66 +42 +16	+52 +15 +57 +41 +16 +36 +8
Systolic B. P.	127	118	140	140	133
Diastolic B. P.	77	76	77	74	72
Pulse pressure	50	42	63	66	61
Pulse rate	78	72	122	122	109
Weight			51.7 48.1 55.8	49.2 53.9	
Before treatment					
Before treatment					
Two weeks after thyroidectomy					
Before treatment					
Before treatment					
Two weeks after thyroidectomy					
Before treatment					
Ten days after second ligation					
After 2 months' rest					
Two weeks after thyroidectomy					
Before treatment					
After second ligation and 2 months' rest					
Two weeks after thyroidectomy					
Before treatment					
After 1 ligation and 2 weeks after thyroidectomy					
Before treatment					
Ten days after 1 ligation					
Two weeks after thyroidectomy					
Before treatment					
Two weeks after thyroidectomy					

<sup>1</sup> This table is extracted from a paper presented by Dr. W. M. Boothby at the Harvard Medical Society, February 17, 1920, Boston.  
<sup>2</sup> The cases in this group of more than five years' duration are omitted from the averages given in the brackets because the duration of the goitre is confused by a pre-existing adenoma.

presented a paper before the Association of American Physicians in which he stated that the thyroid plays an important part in metabolism; that the evidence of high metabolism dominates the clinical syndrome of hyperthyroidism; that the rate of metabolism is dependent on the thyroid hormone, and that this function is not specific for certain tissues, but is common, to all the cells of the organism. DuBois in June, 1916, published the report of the results of his studies of the basal metabolism. The condition of adenoma with hyperthyroidism as described by Plummer is as follows: "Thyroid adenoma with hyperthyroidism is a disease associated with adenoma, characterized by an increased metabolic rate and excited by an excess of the normal thyroid hormone in the tissues. It is clinically evidenced by nervousness, tremor, tachycardia, loss of strength and weight, and a tendency to hypertension; in the later stages myocardial disintegration appears."<sup>8</sup> It is a disease of middle life. The underlying cause or stimulus activating adenomatous growth and over-secretion is not known. Pathologically the thyroid contains single or multiple adenomas in various stages of development or degeneration. The tissue outside the adenomas may be normal or colloid thyroid or contain areas of scattered hyperplasia. The histologic classification and the cellular content are still under investigation.

In the patients with adenoma with hyperthyroidism there was a gradual and appreciable change in symptoms two or three years previous to examination, the patients became nervous and excitable, and in the early stages they were ambitious to work, although unable to maintain physical or mental effort for a long period. These patients have good appetites and think they should be gaining in weight, but find that they are actually losing weight. The skin is warm with a tendency to perspiration. The heart beats faster and harder than normally, especially on slight exertion; it later palpitates, even when the patient is at rest. The blood-pressure often shows hypertension. The symptoms appear gradually and insidiously, usually becoming definitely worse about one year before the patients appear at the clinic; later there are an increase in nervousness and mental instability, moderate tremor, loss of strength, and dyspnoea on exertion; the heart beats rapidly and hard but the beat is not so accentuated as in exophthalmic goitre. In the long standing and more severe cases there is evidence of cardiac insufficiency with more or less oedema of the legs and ankles, often accompanied by myocardial disintegration, shown by irregular rhythm due to the premature contractions or auricular fibrillations.<sup>31</sup> Exophthalmos and gastro-intestinal crises, noted in exophthalmic goitre, are absent. As the duration of hyperthyroidism is prolonged, and the metabolic rate gradually increases, the increased functional demand is supplemented by actual myocardial changes (Willius<sup>32</sup>), resulting from the presence of an excess of the thyroid hormone.

The average age of the patients with adenoma with hyperthyroidism at the time of the examination in two groups of 201 cases and 75 cases, was

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forty-seven and seven-tenths and forty-seven and four-tenths years, respectively; 77 per cent. were more than forty.

The average age of patients with adenomas without hyperthyroidism in whom the adenomas were of sufficient size to justify operation, or for whom the operation was advised as a protection against future hyperthyroidism was slightly less, forty-three and eight-tenths years in a group of 167 cases; this is higher, however, than the average age of all patients with adenomas without hyperthyroidism who come to the clinic.

Exophthalmic goitre brings the patient for examination ten years earlier in life than does thyrotoxic adenoma. Four groups of exophthalmic goitre patients averaged between thirty-three and thirty-six years of age. In thyrotoxic adenomas a goitre is present eighteen to nineteen years before the patient appears for operation; the symptoms of hyperthyroidism have been present about three and one-half years, or twice as long as even the enlarged gland has been noticed in the patients with exophthalmic goitre.

The average metabolic rate following operation and partial thyroidectomy, or removal of the adenomatous mass, falls from + 35 per cent. to + 7 per cent., usually within two weeks. This rapid drop in metabolism is in contrast with the result obtained from thyroidectomy in cases of exophthalmic goitre with an average basal rate of + 36 before operation; the rate is within normal limits within two weeks in only 45 per cent., although it is below + 14 per cent. in 76 per cent. The basal metabolic rate in a series of cases is shown in Table I.

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## SPECIAL CONSIDERATION OF TOXIC ADENOMA IN RELATION TO EXOPHTHALMIC GOITRE \*

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For a long time it has been noted that following the removal of simple goitres, especially those of large size, some patients have reported an improvement in general health beyond what one would anticipate from the mere removal of the enlarged gland. In some cases the improvement has seemed to pertain principally to the nervous system; in some cases to the heart. At first it appeared that this improvement must be in part psychic, *i.e.*, relief from the disfiguring growths; and in part mechanical relief from pressure, relief from interference with the circulation through the large venous trunks, relief from interference with the respiratory exchange.

But with increasing experience it was realized that there was like improvement in cases in which there was no psychic stress; no interference with the circulation in the venous trunks; no interference with the respiratory exchange. It appeared, therefore, that the improvement must be due to the loss of thyroid activity. A comparative study showed also that the changes referred to above more frequently followed the removal of adenomata than the removal of colloid goitres; and that they were most marked after the removal of hyperplastic glands.

The only proved function of the thyroid gland is the fabrication of iodine into an iodine-containing compound which is adapted to the needs of the organism. In hyperplastic goitres this function is most active; but that adenomata also perform the characteristic thyroid function has been shown by the researches of Marine and Allen Graham.

Marine has found that adenomata contain iodine, not as much as is found in colloid goitres, but enough to suggest that they are functionally active; and Graham found that adenomatous tissue affects differentiation in tadpoles as it is affected by normal thyroid tissue. Clinical evidence of the functional activity of adenomata is found in the frequent development of symptoms identical with those which are characteristic of exophthalmic goitre, and in the disappearance of these symptoms after the removal of the adenoma.

In hyperthyroidism due to hyperactive adenomata either iodine or thyroid extract may cause an aggravation of the symptoms.

In view of these facts, the following questions arise: Are these clinical symptoms of so-called toxic adenomata due to a degeneration of the adenoma—such as may occur as a result of the degeneration of fibroid

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tumors? Are they due to such changes as are produced by a chronic toxæmia from infection of the gall-bladder, of the teeth, tonsils, bones, etc., or by intestinal toxæmia? Or are they due to the thyreo-iodine which is fabricated by the adenoma?

That the last of these queries suggests the true interpretation appears to be indicated not only by the identity of symptoms referred to above, but also by the fact that the well-developed "toxicity" from the toxic goitre produces a sensitization of the organism to adrenalin identical with that present in cases of hyperplastic goitre which are associated with exophthalmos and the other characteristic symptoms. In fact, with the exception of exophthalmos, all the characteristic symptoms of true exophthalmic goitre may be present in cases of "toxic adenoma"—increased basal metabolism, tachycardia, increased respiration, nervousness, tendency to fever, low thresholds, emaciation, increased appetite.

On the other hand, in the toxæmias from the toxins of degeneration and in chronic infections, the appetite is not increased, and, as a rule, the basal metabolism is not increased. In certain cases of high blood-pressure, cases of myocarditis, or of neurasthenia, in which the only evidence of the thyroid involvement was the presence of a small goitre, I have excised the gland with good results.

Moreover, if in a case of true exophthalmic goitre, the gland is not hyperplastic, but there is an adenoma, the removal of the adenoma relieves the patient in exactly the same way and to the same degree as the removal of the hyperplastic gland.

The removal of the adenoma gives relief also in those cases of adenomata in which the basal metabolism is not increased, the appetite is not increased, and there is no increased sensitization to adrenalin, but in which there is present myocarditis, or a high blood-pressure or neurasthenia. It would seem as if adenoma caused by every grade of toxæmia progressively from myocarditis, increased blood-pressure, nervousness, and increased metabolism to true exophthalmic goitre. These progressive stages of the disease are analogous to the degrees of infection which vary from mild oral sepsis to empyema of the gall-bladder, acute peritonitis or acute osteomyelitis. It would seem, therefore, that the various types of goitre should logically be regarded as varying degrees of the same or of similar processes.

In view of these facts it would appear that, certainly as far as treatment is concerned, no differentiation should be made between exophthalmic goitre with hyperplasia or thyrotoxicosis from adenomata; that the same regimen of management which has proven effective in the treatment of exophthalmic goitre will produce like results in the treatment of toxic adenoma.

The general management of exophthalmic goitre and the principles upon which it is based have been presented in other papers; but the line

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of treatment is summarized here to emphasize the importance of its inclusive application.

*Special Points in Treatment.*—(a) In advanced cases of toxic goitre, whether of the so-called adenomatous or exophthalmic type, the internal respiration is abnormally sensitive, as is indicated by the adrenalin test (Goetsch), and by the baneful effects of diminished exchange of air as a result of emotion or of injury. Therefore, the operative procedure should be graded according to the severity of the disease.

(b) The anæsthetic should be nitrous oxide which, as a rule, should be administered to the patient in bed, the transference to the operating room being made after anæsthesia is established.

(c) In moderate cases the entire operation may be completed at one séance.

(d) In more severe cases, the thyroid activity is diminished by a preliminary ligation in bed, under nitrous oxide analgesia and local anæsthesia.

(e) In extremely grave cases it may be necessary to diminish the thyroid activity by multiple steps; ligation of one vessel; ligation of the second vessel; partial lobectomy; complete lobectomy; when necessary allowing intervals of a month or more between any two of these stages. If, during operation, the pulse runs up beyond the safety point, the operation is stopped and the wound dressed with flavine, the operation being completed after a day or two, when conditions are safe. In some cases, though the thyroid is resected, it is advisable to dress the unsutured wound with flavine and make a delayed closure in bed the following day under analgesia.

(f) In multiple stage operations the length of interval is determined by the degree of physiologic adjustment.

(g) In certain cases lobectomy is performed in bed.

(h) Psychic control is required throughout to diminish the intense drive by establishing confidence and hope. An *anociated* regimen should be prescribed for the pre-operative, inter-operative, and post-operative periods.

(i) If after operation there is inaugurated an excessively high temperature, with greatly increased pulse and respiration, then on the principle that heat increases chemical activity and electric conductivity, and that these in turn increase heat, such patients are literally packed in ice—packed early. This procedure has been found to exercise a remarkable control over the destroying metabolism.

This post-operative phase of exophthalmic goitre is closely analogous to heat-stroke in symptoms and in control; and both heat-stroke and the so-called post-operative hyperthyroidism are the antithesis of surgical shock in which by contrast the heat centre is functionally impaired. In the latter, heat is as useful as cold is in the former.

The principles outlined above and the development of the treatment are based on the study of my personal series of 2477 thyroidectomies, in-

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cluding 1306 for exophthalmic goitre. The last series since the foregoing completed plan has been routinely used, during the period beginning February 21, 1919, and continuing through April 23, 1920, consists of 562 thyroidectomies with 5 deaths, including 300 for exophthalmic goitre with 3 deaths. Throughout this final series no case has been refused for operation—the operability has been 100 per cent.; the mortality rate of the total series has been 0.88 per cent.; of the cases of exophthalmic goitre, 1 per cent.

## RESULTS OF OPERATIONS FOR ADENOMA WITH HYPERTHYROIDISM AND EXOPHTHALMIC GOITRE \*

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BEFORE drawing conclusions with regard to the results of the treatment of goitres producing symptoms of hyperthyroidism it might be well to define the conditions as they are generally understood at the Mayo Clinic. Changes in the thyroid which apparently produce two definite clinical syndromes that are usually attributed to alterations in the secretory activity of the gland are: (1) Hyperthyroidism of exophthalmic goitre in which the symptoms are characteristic; the changes in the thyroid are always the same and result in a general diffuse hypertrophy and hyperplasia of the gland and (2) adenoma of the thyroid with hyperthyroidism,<sup>3</sup> first described as a clinical entity by Plummer<sup>6, 7</sup> (1911-1912); in many respects adenoma with hyperthyroidism resembles exophthalmic goitre,<sup>8</sup> but on careful examination can be readily recognized as a distinct disease. The activity of the thyroid gland in this condition is confined to the new growths or adenomas in which the hypertrophy occurs, instead of in the normally functioning part of the thyroid.

There is a third syndrome which is often mistaken for hyperthyroidism due to thyroid changes. The patients in this group present nervous manifestations, although the nervousness is of the kind seen in the psychoneurotic person, with tremor and tachycardia, although of a different kind from that met with in hyperthyroidism. The differential diagnosis is at times difficult because the thyroid gland is generally enlarged, due to an increase in colloid; the basal metabolic rate, however, is always normal. The importance of considering this third type apart from the goitres with hyperthyroidism is evident from the fact that this latter group responds to general medical treatment, and surgery is contraindicated.

The symptoms in cases of adenoma with hyperthyroidism apparently result from an increased production of a normal or nearly normal thyroid hormone. While organs such as the other ductless glands and certain parts of the central nervous system may show some changes, the gross changes in the thyroid are constant and permanent and establish a basis for surgical treatment.

The presence and degree of hyperthyroidism in exophthalmic goitre may be determined by several means. The clinical features offer an accurate estimate of the amount of disturbance produced by such changes in the gland. In considering the hyperthyroid cases, the natural course of the disease must be taken into consideration first. Hyperthyroidism occurs in exacerbations. The toxic symptoms develop gradually and after a

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certain time, usually a few months, they reach their climax. If the patient survives the attack, the toxic features gradually subside after a short period, although there is almost never a return to normal, and definite evidence of the hyperthyroidism persists until the beginning of the next attack. Occasionally a spontaneous cure with the disappearance of all evidence of the disturbance occurs.

Loss of weight and strength and increased pulse-rate often reveal the degree to which the toxæmia has progressed. The loss of body weight is particularly important, and by carefully noting this symptom an estimate can be made not only of the degree of toxicity, but also of the relative length of the particular attack. This finding also influences the line of treatment to be followed. It is a well recognized fact that the surgical mortality is unduly high if patients with exophthalmic goitre are operated on while the toxæmia is progressive, or at the peak of a hyperthyroid wave.

Loss of strength indicated by weakness of the extensor muscles and the patient's inability to raise his body up a step, or his inability to walk a short distance, is also an important test of the degree of toxicity. The pulse-rate, nervousness, and tremor are influenced by so many other factors that they do not have the value that loss of weight and loss of strength have in determining the degree of hyperthyroidism.

In a consideration of the cases of adenoma with hyperthyroidism, a different problem is presented, namely, the clinical course of the disease. The thyrotoxic cases are usually those in which an innocent enlargement of the thyroid has existed for a long time. In our series patients with this type of goitre had had an enlargement on an average of almost twenty years before it was associated with symptoms of hyperthyroidism. In the cases of exophthalmic goitre this interval was usually less than one year. Acute crises of hyperthyroidism are not so apt to occur in cases of toxic adenoma as in cases of exophthalmic goitre; the toxic features develop more slowly and are progressively noticeable. Frequently the cardiac symptoms predominate and not infrequently those cases are regarded as "heart disease." There is also a tendency for these cases to be hypertensive.<sup>9</sup> The basal metabolic rate is always increased, but does not average so high as in exophthalmic goitre.

Within recent years much attention has been given to the changes in the basal metabolic rate<sup>5</sup> in both groups of hyperthyroidism,<sup>1, 2, 3, 10</sup> and it is contended by those who have had the most experience in this work that the basal metabolic rate is an absolutely accurate method of determining the presence and the degree of thyroid disturbance. Plummer and Boothby have carried out this study extensively and they believe that in general the thyroid is the main controlling factor in basal metabolism, although other conditions may influence the rate to a certain degree, and that any hypertrophy in the gland will be evident by an increase in the activity, and any reduced thyroid function will be evident by a lower metabolic rate than normal. The degree of hyperthyroidism estimated from the



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clinical features, and the degree of hyperthyroidism determined from the changes in the basal metabolic rate practically always correspond. The adrenalin test is apparently at variance with both the clinical picture and the metabolism studies. In our experience the test when used to determine the presence of toxæmia resulting from thyroid changes has responded almost the same in patients with known hypothyroidism, in normal persons, and in patients with hyperthyroidism. The psychoneurotics have seemed to give the best response to the test. It does not as yet seem advisable to employ the test to determine the presence of toxæmia with a view to operative procedures, for the psychoneurotics, so far as we can determine, do not have thyroid toxæmia. Studies on this subject have recently been reported from our clinic by Boothby and Sandiford,<sup>4</sup> and by Sandiford.

This study of the operative results in exophthalmic goitre and adenoma with hyperthyroidism is based on two selected groups of 100 cases each: One hundred consecutive cases were selected from the list of exophthalmic goitres in which operation was done in 1914, and 100 consecutive cases of adenoma with hyperthyroidism in which operation was done in 1917 and 1918. The list was chosen from 1914 for the exophthalmic group because it seemed that six years is sufficient time to demonstrate the success or failure of operative procedures. The cases in the group of adenoma with hyperthyroidism were chosen from the years 1917 and 1918 because a study of the metabolic rate had been made in all cases; the average time elapsed since operation is two years.

The cases were studied first on the basis of the clinical history and the pathologic findings, and only the cases in which these two findings agreed were selected. Diffuse parenchymatous hypertrophy was definite in all of the thyroids removed in cases diagnosed exophthalmic goitre by the clinician. All the cases of adenoma with hyperthyroidism showed on pathologic examination adenomatous tissue of various types and sometimes scattered areas of parenchymatous hypertrophy; diffuse parenchymatous hypertrophy, such as is typical of exophthalmic goitre, however, was not present.

Letters of inquiry were sent to the patients in each group. Replies were received from all the patients with adenoma with hyperthyroidism and from eighty-eight of the patients with exophthalmic goitre. In the latter group twelve letters were returned unclaimed.

Eighty-eight of the patients with adenoma with hyperthyroidism were females whose average age was forty-eight and eight-tenths years. The twelve males averaged forty-eight and four-tenths years. Eighty-three of the patients with exophthalmic goitre were females averaging thirty-four and three-tenths years, and seventeen were males, averaging thirty-six and six-tenths years.

In adenoma with hyperthyroidism, as Plummer has pointed out, the adenoma usually becomes evident early in life, but the symptoms of hyper-

thyroidism do not develop until middle age. In this series of cases of adenoma with hyperthyroidism the goitre was first noticed at an average age of twenty-nine and eight-tenths years, and the patients came for treatment nineteen years and four months later, after noticing symptoms for two years and five months. In the cases of exophthalmic goitre the enlargement was noted at an average age of thirty-one and two-tenths years; and the patients came for treatment three years and eight months later, after noticing symptoms for one year and nine months.

In the majority of cases clinical examination revealed an enlargement of both the right and left lobe of the thyroid (Table I):

TABLE I

	Cases of exophthalmic goitre	Cases of adenoma with hyperthyroidism
Right and left lobes .....	79	49
Right lobe, isthmus, and left lobe .....	11	14
Right lobe .....	4	17
Left lobe .....	3	10
Isthmus .....	1	5
Right lobe and isthmus .....		4
Left lobe and isthmus .....		
Not stated .....	2	

Consistent metabolic readings were not taken in exophthalmic cases in 1914, but records of ninety-eight pre-operative and forty-four post-operative cases of adenoma with hyperthyroidism were obtained. In some cases several readings were taken and in others only one, so that the figures given represent an average of those taken in each case. The average pre-operative rate was  $+32.7$ , and the average post-operative rate was  $+9.2$ . Some of the post-operative rates were obtained within three weeks after operation, and others within a year or two, but the average number of days post-operatively was twenty-two. These figures agree very well with those obtained by Boothby in a careful analysis of the basal metabolic rates in adenoma and in exophthalmic goitre and with those published by Sandiford.

The choice of operation depends on several important factors, and no fixed rule can be made for any group of cases. The type of operation not only varies for each group, but also for each patient and the stage of the disease. Whereas in the group of cases of adenoma with hyperthyroidism thyroidectomy was done with small risk, in the group of 100 cases of exophthalmic goitre primary or secondary ligation was deemed advisable in sixty-four. Primary thyroidectomy was performed in only thirty-six of this group. This is a higher percentage of ligations than we ordinarily consider necessary, and indicates that this particular group of cases largely represents the severe type. While primary thyroidectomy is the operation of choice and may be done with a comparatively low mortality in the early cases of exophthalmic goitre, in our series only about one in

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three patients presented himself at a time in the course of the disease to warrant dispensing with the preliminary ligation.

In most cases the best operative results are obtained by subtotal thyroidectomy, which is accomplished by removing all except the posterior part of each lobe. The immediate benefit derived from the operation is greater and the recurrences fewer than if lobectomy is done.

Questions in the letters of inquiry were:

1. Do you consider yourself cured as a result of operation?
2. Do you consider yourself improved?
3. Do you consider your condition unchanged?
4. Do you consider yourself worse?

Besides these questions, the patients were given a list of symptoms to report on, such as palpitation, rapid heart, and prominence of the eyes. Various factors which might have influenced their replies were considered; for instance, if the patient reported himself cured and his pulse record and symptomatic condition indicated otherwise, he was not placed among the patients cured.

In Table II are tabulated the interesting facts revealed from a study of the clinical histories with a view to ascertaining which of the most noticeable pre-operative symptoms persisted after operation and which disappeared.

TABLE II

	Symptoms in exophthalmic goitres		Symptoms in adenoma with hyperthyroidism	
	Pre-operative	Post-operative	Pre-operative	Post-operative
Nervousness.....	98	39	88	45
Tremor.....	93	21	83	6
Dyspnoea.....	84	29	76	28
Palpitation.....	89	26	80	29
Tachycardia.....	79	24	72	23
Loss of strength.....	89	13	79	17
Loss of weight.....	89		92	
Vomiting.....	34		8	
Prominence of eyes.....	70		6	
Change of voice.....	25	12	6	11
Heart moderately enlarged.....	38		14	
Heart markedly enlarged.....	19		9	
Murmurs.....	33		28	
Edema.....	20		34	
Exophthalmos.....	67	25	3	
Thrill.....	48		4	
Bruit.....	72		10	
Average normal weight, pounds....	137.3	Average gain 27.3 in 61 cases	151.1	Average gain 31.6 in 82 cases
Average weight at operation, pounds	121.8	Average loss 10.5 in 5 cases	131.7	Average loss 11.5 in 3 cases
Average pulse rate.....	122.6		111	
Average systolic blood pressure.....	145.2		157.2	
Average diastolic blood pressure....	75.6		82.4	

The most common symptoms persisting in each group are nervousness, tremor, dyspnoea, palpitation, tachycardia, loss of strength, and loss of weight. It was difficult to estimate the amount of nervousness that persisted after the operation, and whether the nervousness that many of the patients spoke of was due to any remnant of the disease, because the patients who were apparently otherwise entirely well often complained of some nervousness. Practically the same may be said regarding dyspnoea, palpitation, and tachycardia. All patients who mentioned having any of these symptoms after operation are included regardless of the fact that most of them stated that they were entirely well.

TABLE III

*Exophthalmic Goitre*

Patients cured .....	58 (65.8 per cent.)
Patients markedly improved .....	12 (13.6 per cent.)
Patients slightly improved .....	5 ( 5.6 per cent.)
Patients died from all causes during the six years..	15 (15 per cent.)

More than 65 per cent. of the patients suffering from exophthalmic goitre were free from all evidences of the disease six years after operation. Besides these, 13.6 per cent. are markedly improved; some of them feel entirely well; 5.6 per cent. are slightly improved, although they still have considerable evidence of hyperthyroidism; many of the group have only occasional acute exacerbations. Undoubtedly most of these patients would be benefited by the removal of more of the gland. Fifteen patients have died since the operation, two in the hospital, the others since going home. Some of these deaths were probably due to hyperthyroidism, but deaths from all causes have been included.

TABLE IV

*Adenoma with Hyperthyroidism*

Patients cured .....	83 (83 per cent.)
Patients markedly improved .....	5 ( 5 per cent.)
Patients slightly improved .....	1 ( 1 per cent.)
Patients not benefited .....	2 ( 2 per cent.)
Patients died from all causes during the two years ..	9 ( 9 per cent.)

## CONCLUSIONS

1. Thyroidectomy will cure more than 65 per cent. of patients with the more severe types of thyroidism. If the patients could be treated earlier and with a better understanding of the plan of treatment, in all probability this percentage would be increased considerably.
2. More than 80 per cent. of patients with adenoma with hyperthyroidism can be relieved of their toxic symptoms and a cure obtained by thyroidectomy. A higher percentage of cures would undoubtedly be obtained if the patients were all operated on before there is any evidence of œdema or terminal degeneration.

## OPERATIONS FOR EXOPHTHALMIC GOITRE

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## TOXIC GOITRE\*

BY WALLACE I. TERRY, M.D.

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It is now fairly well recognized that two distinct types of goitre may give rise to toxic symptoms, *viz.*, the hyperplastic thyroid and adenomata. It is further recognized that the symptom-complex may be almost identical with either type of goitre, except that exophthalmos is not present in cases of adenoma of the thyroid, unless there is also hyperplasia of the thyroid tissue itself. It is seldom that the adenomata will produce extreme degrees of toxicity. We owe to Plummer the recognition of the rôle of the adenomata in the production of toxic symptoms, and we are also indebted to Goetsch for his further researches along these lines.

There are, however, many practitioners who do not appreciate the difference between the hyperplastic goitre and the adenomata from the standpoint of treatment. They consider them entirely innocent and advise that they be let alone or may prolong the medical treatment of them until a goitre heart has developed and a cure for the patient is no longer possible. I have thus emphasized the toxic adenomata, because, to my mind, they are not curable by medical means, including the X-ray. Until we have some new measure of real value at our command, it seems to me that the treatment of toxic adenomata should be surgical from the outset. In those occasional combinations of adenomata with hyperplasia, thyroid activity can be lessened by rest and suitable irradiation, but the adenomata will pursue their course despite the treatment.

We all know of apparently spontaneous cures of true exophthalmic goitre, but probably many of these relapse after some years of good health; it has been my experience to operate in two cases where the free interval was nineteen years. It has been stated that exophthalmic goitre is a self-limiting disease and that spontaneous cures result after five or six years in from 60 to 70 per cent. of the cases. Such a statement I think must be founded on a rather limited experience or else the term cure does not mean all it should. Too often do we see patients with unstable nervous systems, irritable and weakened hearts, slight exophthalmos and about normal-sized thyroids, who are supposedly cured, and yet under some toxic stimulus these patients will rapidly go down hill. We see the same thing after surgical treatment, due to insufficient removal of thyroid tissue in some cases, but more often to the fact that the bad nervous systems and the bad hearts were there before the operation. To employ a Hibernianism, the treatment of toxic goitre should begin before it becomes toxic.

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\* Read before the American Surgical Association, May 4, 1920.

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The surgical treatment of mildly toxic goitre is usually most gratifying, but the very severe cases require time, patience, and a recourse to all sorts of expedients to tide them along to a point where it is safe to operate. This safe point is often most difficult to judge, despite the pulse record, the improved weight, and lowered basal metabolic rate, the reaction to epinephrin, and the apparently strong heart. We have no accurate means of determining the resistance of an enfeebled nervous system to psychic or physical trauma, and our estimate of the resisting power of the myocardium is often inaccurate.

To consider personal statistics, up to March 31, 1920, I have done 748 operations for goitre, and of these 527 were for toxic goitres on 504 patients. There were 22 deaths among the toxic cases—a mortality rate of 4.3 per cent., whereas there was but one death among the 216 patients with simple goitre—a mortality rate of less than  $\frac{1}{2}$  per cent. The difference is, of course, striking, but what we should expect, unless one refuses to accept bad risks along with the good ones. The good risks may come in groups, as, for instance, during the period from January 22, 1917, to April 15, 1918, I did 108 operations on 103 patients with toxic goitre without a single fatality, whereas in the next succeeding series of 103 patients there were 8 deaths.

Since 1904, when I did my first operation for goitre, I have classified the toxic cases under four degrees of severity, *viz.*, mild, moderate, marked, and extreme. The classification may be open to question, but it was based on personal judgment, using such factors as pulse-rate, blood-count, tremors, vaso-motor changes, excitability, exophthalmos and more recently basal metabolism. In accordance with this classification, it is found that 155 patients were designated mildly toxic, 86 moderately, 212 markedly, and 51 presented a picture of extreme degrees of toxicity. There were 13 deaths among these 51 extremely toxic cases, 1 of them following the ligation of both superior thyroid arteries and 3 following the injection of boiling water. Some of the remaining 9 deaths might have been prevented by doing less severe operations than resections or lobectomies—they are evidence of the fallibility of my judgment.

Of the 504 cases of toxic goitre, I have accurate pathological reports in 376. The reports show typical hyperplasia in 158 cases, to which should be added 31 cases in which the thyroid was in a resting state, approaching the normal in its microscopical picture. This resting state had been brought about either by the administration of iodine, as shown by Marine a number of years ago, or other medical measures, particularly rest, by irradiation, or by minor surgical procedures. There were 172 cases of toxic adenomata and 13 cases of adenomata with varying degrees of hyperplasia, which latter may be designated "mixed" types.

As a result of the investigation of the prevalence of goitre among army recruits, we know that it is more common in certain parts of the United States than we had anticipated. It was found, for instance, by

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Kerr and Addis that 20.4 per cent. of over 22,000 recruits examined had goitres—these were from eleven northwestern and Pacific states. Only a small number of these had toxic symptoms. If such a proportion obtains in young men, it is reasonable to suppose that they are still more common in young women. It will be the work of the hygienist to solve this problem and when it is done there will be fewer goitres which demand surgical attention.

## THE MANAGEMENT OF TOXIC GOITRE FROM THE SURGICAL POINT OF VIEW\*

BY CHARLES H. FRAZIER, M.D.  
OF PHILADELPHIA, PA.

IN a recent contribution to a current periodical the relative merits of X-ray and surgical treatment are presented from a series of cases, the mortality of which was about 15 per cent. A mortality so high, either after X-rays or operation, seems prohibitive, and the conclusions therefore negligible. So much thought and labor has been given in recent years to safeguarding the patient in the management of toxic goitre that we have a right to expect a better showing. As a matter of fact, surgery to-day is not only the safest but the most effective way of saving life and restoring health. In my own clinic during the past five years, the mortality after resection for toxic goitre was only 1 per cent. and a fraction. My experience with the pathological lesion of the thyroid includes a series of 339 cases which form the basis of these remarks.

The absorbing interest of the thyroid gland has aroused inquiry in the minds of many. From the laboratories, the internists and the surgeons there is a continuous output of contributions, of greater or less moment, in mass indicating the widespread interest in the many-sided aspects of thyroid disease. As most entertaining, though chiefly of historical value, is the "Operative Story of Goitre," by Halstead. Here is recorded Gross' point of view as to the propriety of removing a goitre. About half a century ago he wrote, "Every step he takes will be environed with difficulty, every stroke of his knife will be followed by a torrent of blood, and lucky will it be for him if his victim live long enough to enable him to finish his horrible butchery. Thus, whether we view this operation in relation to the difficulties which must necessarily attend its resection, or with reference to the severity of the subsequent inflammation, it is equally deserving of rebuke and condemnation. No honest and sensible surgeon, it seems to me, would ever engage in it."

What a transformation there has been from this picture of butchery to the refined technic of the modern thyroidectomy!

The interrelationship between the thyroid and the adrenals has long been recognized. In differentiating between the sympathetic and vagus hypertonic types of hyperthyroidism, Kostling (*Grenzgebiete* 21, 1910) a number of years ago considered an adrenalinæmia as the most important sign of the former and called attention to the dilatation of the iris on the installation of adrenalin. More recently Goetsch has recommended the test as a point in diagnosis in the border-line cases, cases resembling in some respects true

\* Read at the Conjoint Meeting of the New York Surgical Society and the Philadelphia Academy of Surgery, February 2, 1920.

hyperthyroidism, but without definite recognizable signs. Did this test prove infallible, we would have a valuable guide in the selection of cases for operation in this borderline group. I welcomed it as such, for in a certain number of instances, with but trifling enlargement of the gland, but without a clear picture of hyperthyroidism, I have been in a quandary as to the propriety of operating. I have applied the test routinely during the past few months, but have found it yet of little aid, and my skepticism has been aroused by negative reactions even in a typical exophthalmic syndrome.

To me one of the most practical problems of the surgery of toxic goitre is the determination of the degree of toxicity. This has a practical bearing upon the choice of operation. Kocher (*British Medical Journal*, Oct. 1, 1910) told us ten years ago that in the blood picture we had a very important aid as to prognosis and laid emphasis especially upon the relative increase in the lymphocytosis, he looked upon the degree of lymphocytosis as an evidence of the degree of toxicity. While it is quite true that, as a rule, the degree of the lymphocytosis bears a relationship to the gravity of the case, I have not found it by any means a constant guide as to the operative risks or as to the tolerance of the patient to surgical therapy.

What may prove to be a more dependable objective test is the determination of the basal metabolism, and the new Benedict apparatus, which we have installed as part of our equipment, has simplified this method of determination to a considerable degree. The estimation of the basal metabolism is, however, of more importance as a means of differential diagnosis in cases of obscure clinical picture with thyroid enlargement. In one of my series there was a great deal of doubt as to the relationship between the enlarged gland and a train of symptoms that were by no means typical. In this case the metabolism was not above but subnormal, so that an operation not only would have given no relief but would have been distinctly harmful. Metabolic studies serve the useful purpose, therefore, of enabling one to make a fairly accurate differential diagnosis between true hyperthyroidism and, for example, simple neurasthenia.

Means and Aub (*Arch. Int. Med.*, Dec., 1919) make the significant statement that for the most part patients with goitres, but without clinical signs of thyrotoxicosis, not only have a normal metabolism but that such cases do not subsequently become toxic.

Studies of the basal metabolism, I believe, should be made routinely in all cases of hyperthyroidism or for that matter of hypothyroidism, with just the same regularity as one should take the white-cell count in appendicitis or examine the urine in diabetes. This is true not only because of its value in differential diagnosis but because of the parallelism between the other signs of toxicity and the basal metabolism. For example, in the cases which clinically I would regard as severe, I find the basal metabolism runs something like this: plus 66, 78, 74, 68, 80, 73, 81, 93, etc., while of those cases of moderate severity it varies from plus 45 to plus 65 and the mild cases run below 45. To this statement it should be remembered, however, there are



## THE MANAGEMENT OF TOXIC GOITRE

noted exceptions and for this reason particularly one must still hold somewhat in abeyance the evaluation we are to place upon these metabolic studies in the management of new cases. For example, two patients with precisely the same metabolic rate may not be equally good surgical risks. Occasionally one sees a patient with a high metabolic rate with an unusually good tolerance to operation and vice versa. Again, a patient with a given metabolic rate may at different times be a good or a bad surgical risk. I have not been able to demonstrate that the metabolic rate always increases *pari passu* with exacerbations or crises. For these and other reasons the composite picture must be our guide as to what shall be our plan of action. Careful observation of each patient for at least a week, and two weeks, preferably, with attention to the cardiovascular symptoms, the vasomotor disturbances, the nervous and mental instability, in association with the blood picture and metabolic studies, will give us often much more satisfying and dependable data than any single objective test.

For practical purposes elaborate classifications of the toxic cases is unessential. The toxic adenomata may present operative problems quite as grave as those of hyperplastic type. Some of the most serious cases with which I have had to deal have been of the adenomatous group, with high metabolic rates and profound disturbances of the myocardium, cardiac rhythm and function, and while the technical difficulties of resection are not as great as with the toxic hyperplasias, the patients require just as much attention in the preliminary treatment and after-care.

Every available agency must be called into play in the nursing of these patients back to health. Rest, of course, is helpful in the preparation of patients for operation, but of itself will reduce the basal metabolism from only 10 to 15 per cent. Even this slight improvement should be taken advantage of. With hydrobromate of quinine I have had no demonstrable results and I was interested in the observation (Means and Aub) that the effect of rest plus hydrobromate of quinine had no more influence on the basal metabolism than rest alone.

In the extremely toxic cases I always prescribe X-ray treatments, but the results have not been altogether satisfactory. It is in those cases in which there is the slightest suspicion of an enlarged thymus that irradiation should be employed. There is not the least doubt that an enlarged thymus is responsible for many of the sudden deaths following operation and irradiation should be prescribed and practised in all such cases preliminary to operation.

With regard to the X-rays therapeutics in general, all the reports which I have seen deal in generalities and do not give in detail the end results. The writers of these reports would lead us to believe that the results are almost uniformly good and one would infer better than the results of surgery. The insinuation is made also that X-ray therapy is without danger in itself. To this, however, I take exception; in the first place, Holmes and Merrill (*Journal A. M. A.*, 73, 1963, 1919) tell us that the gland may be destroyed and a state of hyperthyroidism produced if the treatment is pushed too fast.

The changes go on in the gland some time after treatment is discontinued. Secondly, the toxæmia may be increased to a dangerous degree by the first treatment and cases have been recorded (Secher) where the reaction following Röntgen therapy has been fatal. Thirdly, the increase in connective tissue makes subsequent operation more difficult.

The problem uppermost in our minds to-night is the surgical treatment. There can be no doubt as to the propriety of operation; the results are too striking to place the surgeon in a defensive attitude. It is a question only under what circumstances and by what method one shall proceed. That surgical procedure shall not be brought into disrepute, we should avoid certain pitfalls, and among these I would mention first of all the neurasthenias with enlarged glands between which there is no relationship of cause and effect. Fortunately the differentiation can now be demonstrated by objective tests. In the second class I would place the mildly toxic cases of adolescence, for here we have a physiological enlargement and the need of the economy is not less thyroid tissue in most instances but more iodine.

The third group among the undesirable include the thymic cases, and I have already referred to the necessity of preliminary X-ray treatment; in the fourth group I would place the wreckage, the cases in the terminal stage of the disease, the utterly hopeless cases; and in the fifth group the cases of hypothyroidism. I will not elaborate upon these several groups. Their recognition implies often careful, intensive study, but if our records of surgical achievement are to be above criticism, those groups should not be included among our operable cases.

In recommending operation shall we discriminate between the mild, moderate and severe cases? In the very mild cases, operation is not urgent; by change of occupation and other simple remedies (the care of teeth infection, the removal of infected tonsils and the like) there may be some improvement. But even without improvement, if the condition remains stationary and does not handicap the patient, operation remains one of choice rather than of necessity. But in the moderate cases I have always urged operation, because these are on the threshold of a condition that must always be considered potentially grave. There is no doubt at all that a certain percentage of cases recover spontaneously; nor is there any doubt that a certain percentage are improved or recover by what is called medical treatment, essentially rest; but it is equally true that these are subject to recurrences or relapses, and, whether the patient has been under medical treatment or not treated at all, every crisis of hyperthyroidism through which the patient passes leaves that patient a poorer surgical risk. This point must always be borne in mind by those who advise a "course of medical treatment." The degenerative changes, which take place in the vital organs during the period of procrastination, are permanent and preclude the ultimate and complete recovery of the patient. For these reasons, therefore, I take a firm stand as to the propriety of early operation.

Whether to begin the operative treatment with a resection or with a

## THE MANAGEMENT OF TOXIC GOITRE

preliminary ligation, I think admits of no discussion. It has been my practice to resort to preliminary ligation when there is the least doubt as to the propriety of a resection, and as time goes on I find the number of preliminary ligations is increasing rather than decreasing and single ligation I prefer to double ligation at one or two weeks' intervals. As a rule, with a metabolic rate over 60, I always practice preliminary ligation, and in cases of lower metabolic rate when the other signs of great toxicity are evident in the rapid pulse, much loss of weight, restlessness, sleeplessness, and particularly marked vasomotor disturbances. The operation is performed in the patient's room, and according to our "anoci" technic the patient does not know that she has had more than an unusually severe "inhalation" treatment. I believe there are sound anatomical reasons for selecting the superior pole and I always surround the pole with two ligatures and divide all the tissues between, which includes thyroid tissue, cervical sympathetic fibres, lymphatic vessels, in addition to the arteries, that is the main trunk and its posterior branch.

There is but one objection, and only one, to preliminary ligation, and that is the additional scars. But the greater safety far outweighs any consideration of cosmetics. To make the scars less conspicuous, I place them always in a crease in the neck. Almost invariably one of two creases will be found near enough to the level of the pole to answer our purpose, and if the incision follows the crease accurately the scar will be quite inconspicuous.

I need not dwell upon the improvement after ligation, as you know in most cases it is striking as to pulse-rate, weight, basal metabolism and other indices of improvement. There is but one point that should be emphasized in this connection. The resection should follow at an interval of not more than two or three months. The maximum improvement is noted about that time and there may, and in most cases will be, relapses as the compensatory circulation increases in volume. In a few cases the patient may feel so much better that she or he will not return. This is a risk one takes in the practice of ligation. In some the improvement will not be so apparent, but as the vascularity of the gland has been appreciably diminished, the final operation will be attended with less bleeding. The difference in degree of improvement is difficult to account for, except perhaps on an anatomical basis, since the four arteries are subject to considerable and frequent variation. The superior arteries may both be very small, the inferior correspondingly large or vice versa. Whatever the explanation, I find great variations in the results. In the exceptional case the condition may be temporarily aggravated as in a recent observation where the metabolism rose from 49 to 66 after a single ligation.

But even though the preliminary ligation may not have been followed by as much improvement as had been anticipated, this step in the management of goitre serves a useful purpose. The reaction of the patient to the minor procedure is a very good index of the degree of reaction that may be anticipated after the final thyroidectomy. In some instances the thyroidectomy,

if the reaction is slight, may be performed two weeks rather than two months after the ligation.

The ultimate and total result of surgical interference follows the resection of the gland. In the preparation of the patient our "anoci" technic following the principles of Crile is strictly observed without variation. It matters not by what seductive method the gland is "stolen," the advantages of the principles involved cannot be overestimated, and with a trained staff of assistants and nurses the patient need not know the gland has been removed until she returns home. The measure of success in the surgical treatment of hyperthyroidism is in direct proportion to the amount of tissue removed. The incomplete or partial relief of symptoms, the relapses or recurrences must be charged to the failure to remove enough tissue. The resection should be bilateral even though the pathology seems confined to one lobe. I have never removed too much and more than once in earlier days too little. At least symptomatically there have been no instances of myxœdema, although in one instance the basal metabolism was minus. It is difficult to express in figures what proportion of tissue should be removed; some say four-fifths, some five-sixths. This, I believe, is too much if based on the size of the lobes with their pathological accession. If one leaves a thin layer of thyroid tissue, lining that portion of the capsule which remains after resection, there will be quite enough for the body economy. All operations are performed under nitrous oxide anæsthesia. According to our technic and to our conception of the advantages of the control of psychic influences local anæsthesia is distinctly contra-indicated.

In the final analysis the value of the surgical treatment of the toxic goitre must be estimated in terms of end results. The mortality now is far below that of any other method of treatment and each year the mortality is lowered. As for the end results, I have not been able to review my entire series, but in the analysis made before the war 80 per cent. of the patients heard from were recorded as recovered, either altogether or sufficiently to enable them to resume their occupations. The degree of recovery, be it remembered, must depend upon whether at the time of operation the ravages of the disease had damaged beyond repair the vital organs.

## A "TOURNIQUET OPERATION" IN TOXIC AND OTHER GOITRES\*

By LEONARD FREEMAN, M.D.  
OF DENVER, COLO.

WHEN operating upon a toxic goitre it usually is better to remove a part of each lobe than the whole of one lobe, not only for cosmetic reasons, but because diseased glandular tissue is less liable to be left behind. Also, secretion is diminished in the remnants of the gland from the division of blood-vessels and from cicatricial contraction.

Hence, partial, bilateral thyroidectomy is the operation of choice, and it becomes a matter of importance to develop a rapid and safe technic adapted to the limitations of the average surgeon. With this object in view, I desire to call attention to a method which I have employed for a number of years, accumulating experience having convinced me of its value. I have used it one hundred and eighty-two times and have found it applicable to all kinds of goitres—large, small, soft, vascular, and hard—with the exception of those which are calcified. In this series of cases I have never injured the recurrent laryngeal nerve or, to my knowledge, the parathyroids, and I believe such danger to be practically negligible, even with comparatively inexperienced operators.

*Operative Technic.*—The preliminary steps are those employed in most goitre work—collar incision, exposure of the gland and dislocation of its lobes. It seldom is necessary to divide any muscles, as is done often in other procedures.

From this point on, the technic differs. It has for its object the placing of a tourniquet around the base of each lobe, before partial excision, so as to control hemorrhage by compression of *all* the vessels without injury to the nerves or parathyroids. This is done by means of two wires, one on either side of the base of the lobe, held in place by elastic bands passing through the glandular substance.

The necessary equipment (Fig. 1) consists of a number of ordinary strong rubber bands, two or three inches long and somewhat thicker than the lead in a pencil; two pieces of wire of a similar diameter and three or four inches in length, with the ends turned over into small loops to prevent injury to gloves or tissues (large hairpins will suffice); and a pair of small alligator forceps.

The consecutive steps are as follows: (1) Elevate one of the thoroughly dislocated lobes with the fingers or with appropriate forceps. (2) Plunge the alligator forceps directly through the base of the lobe near

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\* Read before the American Surgical Association, May 4, 1920.



its centre and close to the trachea, grasp a rubber band and pull it through, so that an end projects from either side. Repeat the manoeuvre near each extremity of the lobe, so that its base remains transfixed by three loops (Fig. 2). (3) The wires, which must be long enough to project well beyond the lobe at either end, are now passed through the three loops on each side (Fig. 2). (4) With the lobe well elevated, and an assistant holding the ends of the wires together, the central band is pulled taut and clamped close to the wire with hæmostatic forceps, thus binding the wires firmly together (Fig. 3). The two remaining bands are manipulated differently. After pulling on them until they are tense, each strand is wrapped in an opposite direction about the projecting ends of the wires before clamping, so as to insure the constriction of the vessels at either pole (Fig. 3). (5) The portion of the gland beyond the tourniquet is then excised with scalpel and scissors, leaving only a sufficient cuff on either side for the insertion of a hæmostatic suture (Fig. 4). One can take one's time in doing this, the bleeding being perfectly under control. An important point is that the elastic contraction of the rubber bands maintains the hæmostatic pressure of the wires even though much tissue is removed from between them.<sup>1</sup> (6) With a long catgut suture the raw area is whipped over, utilizing the lateral "cuffs" in the procedure (Fig. 4). It may be desirable to go back over the first suture-line, so as thoroughly to control the bleeding, but it seldom is necessary to tie any vessels separately, not even the thyroïdal trunks. (7) After unclasping the forceps which hold the rubber bands, the wires and bands are removed. There usually is no bleeding of consequence from the punctures through the gland substance, but if any should occur it can be checked by pressure or a suture. (8) The wound is then closed and drained. (9) An enlarged isthmus may require separate handling, or it may be removed along with a lateral lobe, by including it within the grasp of the tourniquet, as I have often done. I do not consider it necessary to divide the isthmus in any but exceptional cases.

The advantages of this method of operating are several: (a) Bleeding from *all* the vessels is completely controlled. (b) No hæmostatic forceps are required after applying the tourniquet, thus avoiding an embarrassing profusion of instruments, not to mention the danger of injuring a nerve in their application. (c) The wires cannot slip when the gland is cut away, because they are held in position by the elastic bands passing through the stump. (d) The safety of the recurrent laryngeal nerve and parathyroids is assured by the wedge-shaped excision, and even if they should be caught in the grasp of the wires the pressure is not great enough to damage them permanently.

This constriction without crushing is important, and is one of the reasons why the wire tourniquet is superior to the use of large forceps

<sup>1</sup> The elastic bands are superior to fishing-line, which I used exclusively until recently (Colorado Medicine, Jan., 1916).

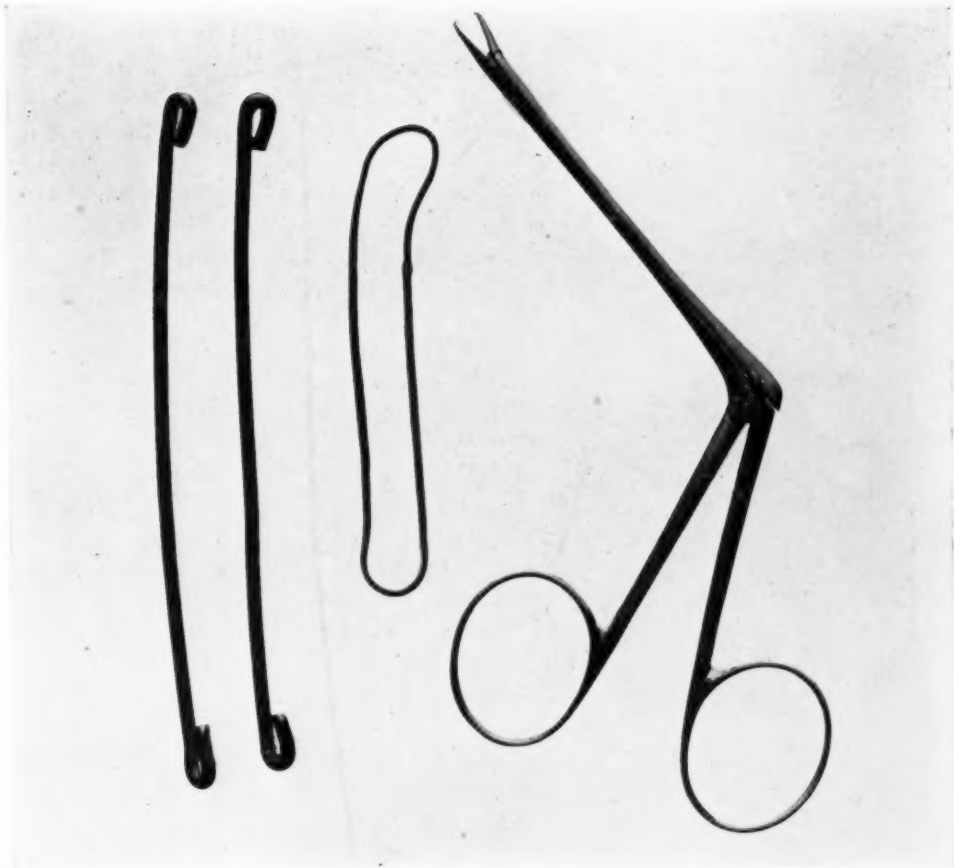


FIG. 1.—Showing wires, rubber bands and alligator forceps.

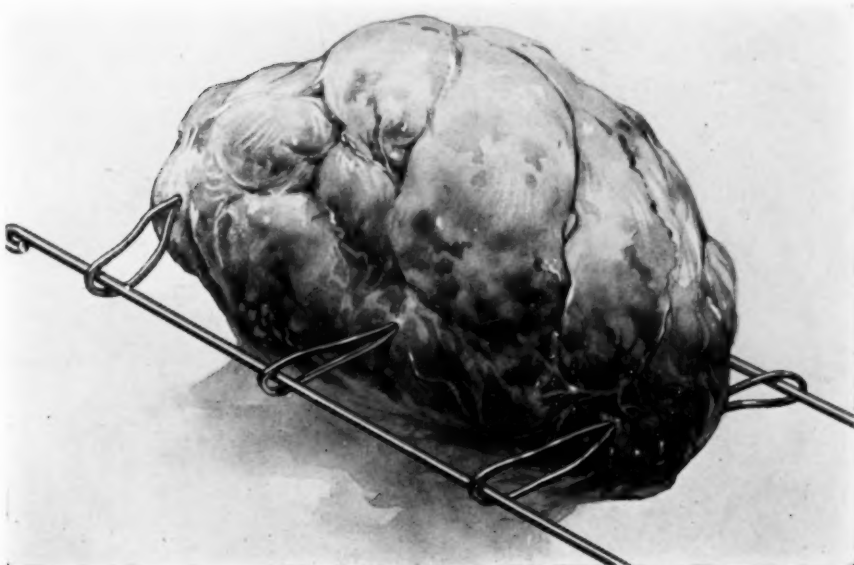


FIG. 2.—Rubber bands drawn through base of lobe and wires inserted through the projecting loops on either side.

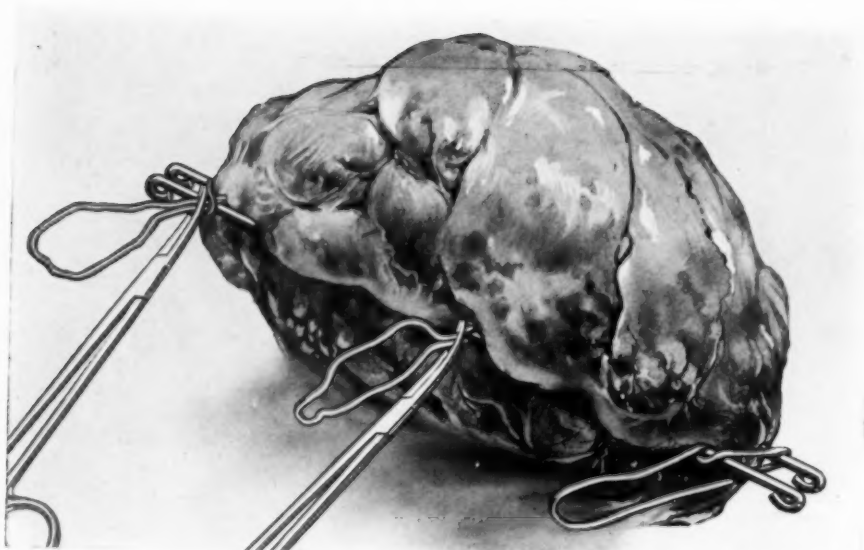


FIG. 3.—Rubber bands drawn taut and held by forceps, the end bands having been wrapped around the extremities of the wires.

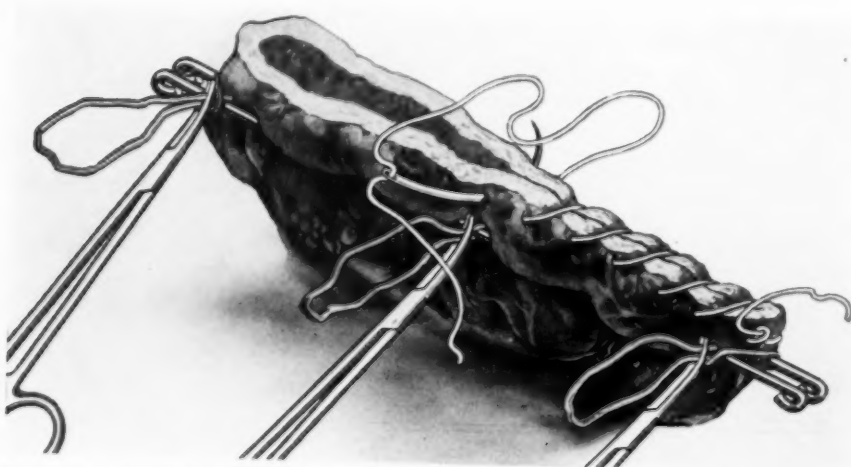


FIG. 4.—Showing wedge-shaped excision and method of inserting hemostatic suture. (For the sake of clearness the "cuff" is pictured unnecessarily wide and thick.)

### "TOURNIQUET OPERATION" IN GOITRES

which are sometimes similarly employed; for if the forceps are closed tightly enough to prevent slipping they will crush, which is undesirable in toxic goitre, and may injure the nerves and parathyroids. In addition, forceps occupy more room than wires and often are difficult to apply, because of the thickness of the lobe and because they cannot be bent to conform to varying conditions.

Anyone who sees fit to try this method of operating will find it easy, safe, comparatively bloodless, and rapid. Its merits will be especially appreciated in the soft and vascular goitres of toxic type.

## THE RELATIONSHIP BETWEEN RANULA AND BRANCHIO-GENETIC CYSTS \*

BY JAMES E. THOMPSON, F.R.C.S. (ENG.)

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THE name "Ranula" is usually applied to a cyst with mucous contents which is found underneath the mucous membrane covering the floor of the mouth on one side of the frenum of the tongue. The wall of the cyst is thin and is loosely attached to the surrounding tissues. It consists of fibrous tissue of a loose variety. The inner surface is often covered by a single layer of tessellated epithelium. The contents are of mucus of the consistence of white of egg. These cysts vary in size. They rarely cross the midline. When large they extend outwards and downwards. Wharton's duct and the sublingual gland can usually be seen superficial to the cyst but apparently not structurally connected with it. The cyst usually lies entirely within the buccal cavity on the upper surface of the mylohyoid muscle (Fig. 1, A). Not infrequently a prolongation of the cyst extends around the posterior border of the mylohyoid, producing a swelling in the submaxillary region (Fig. 1, B) which may reach the size of a small mandarin orange. Occasionally the submaxillary swelling may consist of two separate cysts, one of which alone communicates with the intrabuccal cyst (Fig. 1, C).

Various theories have been advanced from time to time to account for the presence of ranula. Up to the present time none has been satisfactory. It has always appeared to me that a cyst which presents such consistent anatomical and pathological features must have one and only one origin; and, therefore, I have never believed that a ranula could at one time be derived from Wharton's duct, at another from the sublingual gland, at another from one of the mucous glands, and at still another from an adventitious bursa (Fleischmann's). I have satisfied myself in every case of ranula that has come under my observation that neither Wharton's duct nor the sublingual gland are responsible, by finding that these structures were healthy and normally placed. To refuse to believe that some cysts may not have their origin in the mucous glands of this region would be unwise. One meets with examples of mucous cysts of considerable size arising in the mucous membrane of the mouth. These cysts, however, are very superficial, very closely connected with the mucous membrane and do not separate it from the subjacent tissues. In other words, they do not show the frank burrowing qualities of true ranula. As to Fleischmann's bursa I may say frankly that I have never seen it, and further, that many anatomists in a life's experience have failed to satisfy themselves as to its real existence.

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\* Read before the American Surgical Association, May 5, 1920.



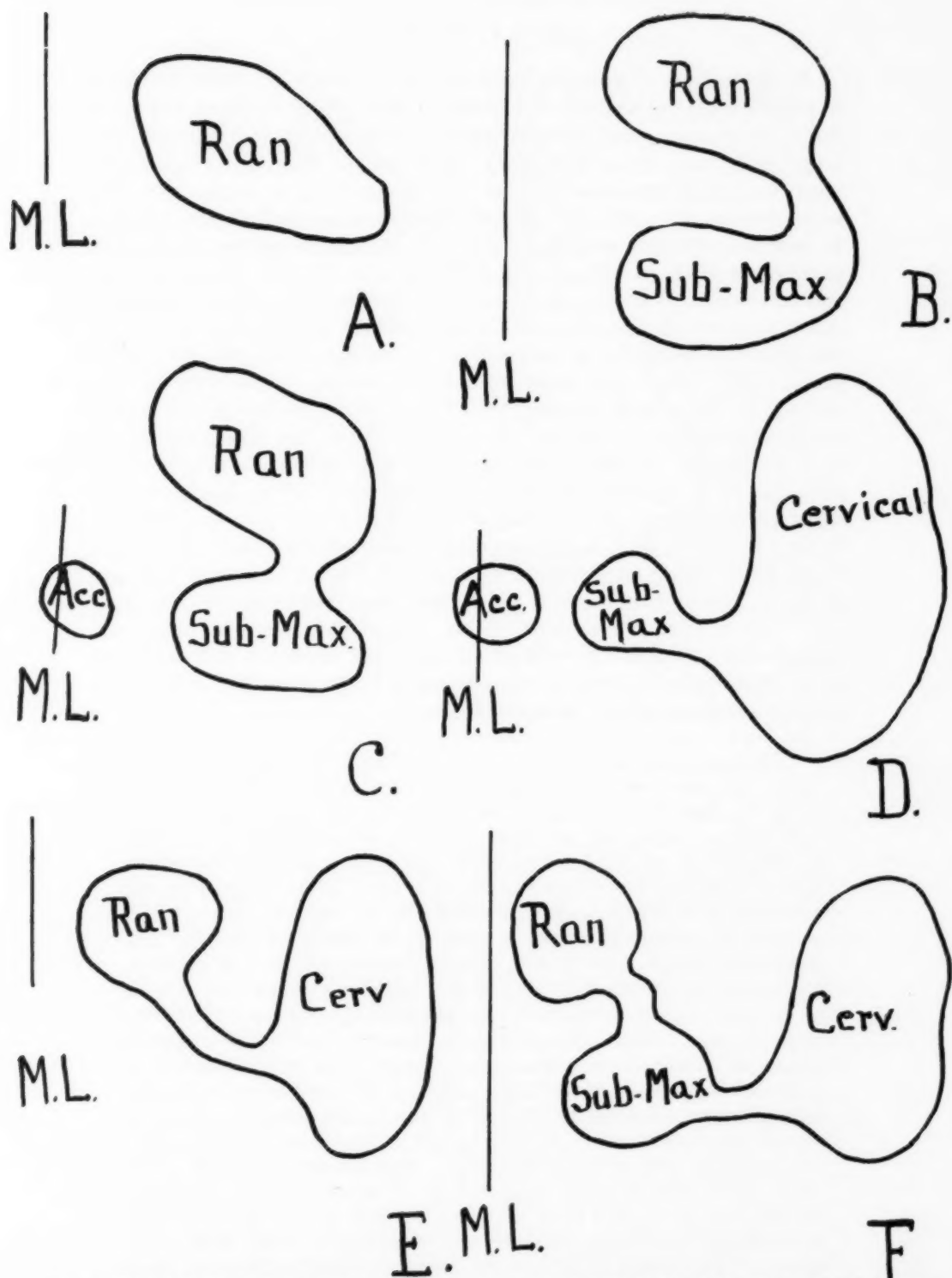


FIG. 1.—(Original V. K.) A diagrammatic representation of the anatomical distribution of the cysts met with in the deep cervical, submaxillary and sublingual regions. *A*, represents a simple ranula. *B*, a ranula and submaxillary cyst communicating with one another by a neck. *C*, a ranula and submaxillary cyst communicating with each other; also a small isolated cyst in the submental region. *D*, shows a deep cervical cyst communicating with a submaxillary cyst; also an isolated submental cyst. *E*, shows a deep cervical cyst communicating with a ranula by a long narrow neck which traverses the submaxillary region. *F*, shows a deep cervical cyst communicating with a submaxillary cyst which in turn opens into a ranula. The letters *M L* mean "middle line of the neck." For purposes of comparison all the cysts have been drawn on the left side of the body.

JAMES E. THOMPSON

With the hope of throwing some light on the origin of ranula I venture to present a careful analysis of a group of cases which I believe will prove that a direct relationship exists between cysts of undoubted branchiogenetic origin and cysts in the submaxillary region and the floor of the mouth. In 1906<sup>1</sup> I reported two cases of cysts of the upper region of the neck that were identical with each other in their anatomical and pathological features. In each case the cyst was deeply placed in the upper portion of the neck under cover of the parotid gland and the ramus of the jaw. In one case the cyst communicated with a ranula under the tongue by a narrow communicating track which passed across the submaxillary region (Fig. 1, *E*). In the other case there was no ranula, but the cyst opened in front by a short passage into a large cyst occupying the submaxillary region (Fig. 1, *D*). In front of this a small accessory cyst was found in the middle line underneath the symphysis of the jaw (Fig. 1, *D*). Since that time a number of cases of cervical cyst have come under my observation identical in every particular as to structure and location. Each cyst had associated with it either a submaxillary cyst or a ranula, or both, with which it communicated freely. In Fig. 1, *D*, *E* and *F*, drawings of the different types of cyst are shown which picture in a striking manner their close relationships with one another. Two of these types, *D* and *E*, were described in my original paper and I have verified the accuracy of my original description by cases seen subsequently. Type *F* has been added since, and inasmuch as it embodies all the most typical features of these compound cysts it will be used as the basis of a common clinical and pathological description.

The history and anatomical findings are as follows: Mrs. L. F., aged thirty-one years, white, came under my care suffering from a ranula under the left side of tongue, which was the size of a walnut. The submaxillary region of the same side was also occupied by a cystic swelling which increased in size when pressure was made on the ranula. The two cysts evidently communicated freely. In addition there was a swelling between the angle of the jaw and the mastoid process, which obliterated the natural hollow in front of the lobule of the ear. The ranula had been noticed a few years previously and several attempts had been made to cure it by tapping and snipping out parts of the walls of the cyst. The swellings in the submaxillary and parotid regions were of recent onset. Recognizing the nature of the case I suggested operation. The neck was opened by a semicircular incision such as is employed for ligature of the lingual artery. The ranula and submaxillary cyst were dissected out in one piece. It was found necessary to remove the submaxillary salivary gland to facilitate the dissection. The posterior part of the submaxillary cyst led into a narrow neck, which penetrated the deep compartment of cervical fascia separating the submaxillary gland from the deep cervical fascial space to open finally into a large cavity which lay in the upper part of the neck under cover of the parotid gland and the inferior maxilla. This contained

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<sup>1</sup> Texas State Journal of Medicine, December 7, 1906.

## RANULA AND BRANCHIO-GENETIC CYSTS

thin mucus and its walls were smooth and firmly attached to the surrounding tissues. The boundaries of the cavity were as follows: *Above*, one could feel the base of the skull represented by the under surface of the petrous portion of the temporal bone. All the bony irregularities were clearly distinguishable. *Below*, the cyst wall turned on itself about the level of the greater cornu of the hyoid bone. *Externally*, one could feel distinctly the inner surface of the ramus of the inferior maxilla covered by the internal pterygoid muscle, the projection of the spine of Spix and the deep surface of the parotid gland. *Posteriorly*, the anterior surface of the mastoid and styloid processes were clearly palpable. *Internally*, the cyst extended for a short distance in front of the transverse processes of the upper cervical vertebræ. The internal carotid artery could be felt very close to the posterior wall of the cyst. A small portion of the cyst wall was removed and stained for epithelium. No epithelial lining could be demonstrated. Complete removal being clearly an impossibility, the mucus contents were evacuated and the interior of the cavity thoroughly scrubbed with gauze soaked in tincture of iodine. A drainage tube was inserted. This was retained two days and then removed. After considerable reaction the wound healed up by first intention and the patient left hospital at the end of three weeks apparently cured. I heard from the patient about a year afterwards and found that the cervical part of the cyst had refilled and that she was contemplating another operation.

All the cysts seen so far have been so characteristically alike that the above description is accurate in its main essentials for every one of them as regards the cervical compartment. Considerable variation has been present in the submaxillary and lingual regions. Fig. 1, *D*, *E* and *F* represent the types observed so far. It is almost certain that further experience will reveal others.

Microscopic examination of the lining membrane of the cyst wall has been rather unsatisfactory. In most cases we were unable to find epithelium. When present it was of the tessellated variety. The fibrous tissue was fairly dense and the fibrous bundles were separated by large lymph-spaces containing very few cellular elements.

I have made a somewhat exhaustive search of reported cases, but so far I have been unable to find cases that correspond anatomically to those reported above. The anatomical boundaries of the cervical portions of these cysts are so unusual, definite and consistent as to negative mere coincidence as to structure and origin and to make it reasonably certain that they result from a definite cause and therefore are likely to be met with true to type in the practice of every surgeon. It is more than probable that they are not rarities but that they have escaped accurate description. A study of *A*, *B*, *C*, *D*, *E* and *F* in Fig. 1, leads one to the inevitable inference that each picture is a complement of all the rest, like fragments of a picture puzzle, and that the different cysts have a common origin. They give us the impression of being daughter cysts which have been segregated from a mother

cyst and carried by some agency into regions remote from their original home, during which process obliteration of one or more of the daughter cysts or even of the mother cyst has occurred, producing a final picture corresponding more or less closely with one of those in the figures. The potentialities of such a mother cyst are present in the neck of the human embryo of four weeks at a period when the external gill cleft depressions are existent and the cervical sinus is in process of formation. The persistence of the cervical sinus in whole or in part is probably responsible for all branchial cysts and fistulae, and, inasmuch as the stages in its development are inseparably connected with those of the branchial arches and clefts, it will be necessary to add a description of the life history of the latter to enable us to handle the subject intelligently.

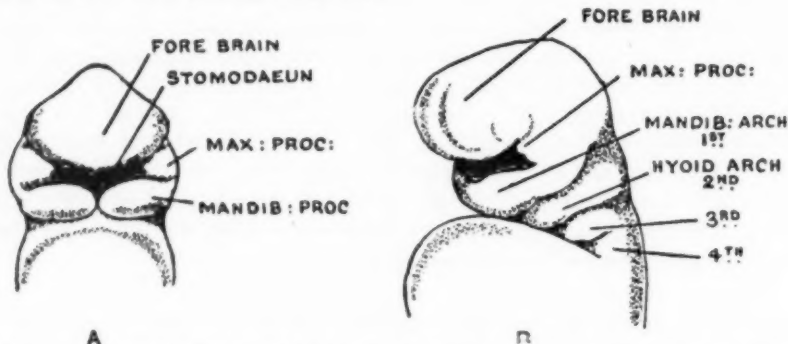


FIG. 2.—(From Keith's Human Embryology.) The branchial arches and stomodæum of a human embryo of the third week. Front and side views.

In the third week of foetal life the branchial arches make their appearance (Fig. 2). The pharyngeal region of the embryo resembles that of an adult fish, but whereas in fishes the arches are separated by clefts, here they are separated by depressions. These depressions, generally spoken of as internal and external cleft depressions, are visible on the outer aspect of the neck and the inner aspect of the pharynx. They are separated by a membrane which is lined on its outer side by epiblast and on its inner side by hypoblast (Fig. 3). In the normal course of development the membrane never disappears, so that it is incorrect to speak of gill clefts in the human embryo in the same sense that we use the term in referring to fishes. In the rare instances in which the membrane is perforated a complete cleft is formed which may persist in the adult and may be the forerunner of a branchial fistula. The growth of the neck is so rapid that by the end of the sixth week all external evidence of the branchial arches and cleft depressions has disappeared.

#### BRANCHIAL ARCHES

Six arches are usually described, of which four can be distinguished on the surface of the neck (Fig. 2). The posterior ends of the two anterior are connected with the bony skeleton, but those of the posterior four lie free

## RANULA AND BRANCHIO-GENETIC CYSTS

in the tissues. Each arch contains: (1) a basis of cartilage; (2) a vascular arch; (3) nerves; (4) muscle elements (Fig. 3). *The first arch* is the mandibular. Its basis (Meckel's cartilage) forms the foundation of the lower jaw, although the greater part disappears. The posterior end persists as the malleus and the anterior end as the part of the lower jaw which carries the incisor teeth. The nerve of the arch is the third division of the fifth. The artery of the arch disappears but the origin of the external maxillary (facial) marks the place where it arose from the ventral aorta (external carotid). The *second arch* is the hyoid. Its posterior end persists as the stapes, the middle portion as the styloid process and stylohyoid ligament, and the anterior end as the lesser cornu of the hyoid bone. The nerve of this arch is represented by the facial and auditory (7th and 8th). The artery of the arch disappears, but the lingual artery marks the place where it arose from the ventral aorta. The *third arch* is represented in the adult by the great cornu and body of the hyoid bone. Its nerve is the glosso-

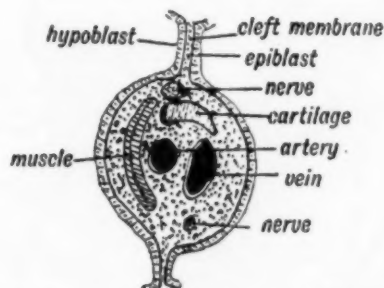


FIG. 3.—(From Keith's Human Embryology.)  
Schematic section of a visceral arch.

pharyngeal (ninth). The artery of the arch persists as the first part of the internal carotid. The superior thyroid arises from its place of origin from the ventral aorta. The *fourth arch* is represented in the adult by the upper part of the thyroid cartilage. Its nerve is the superior laryngeal branch of the vagus. The vascular arch is represented on the right side by the first part of the subclavian artery, and on the left side by that part of the arch of the aorta between the origin of the left carotid and the point of entrance of the ductus arteriosus. The *fifth arch* is represented in the adult by the lower portion of the thyroid cartilage. Its nerve is the inferior laryngeal branch of the vagus. The *sixth arch* is represented in the adult by the cricoid and arytenoid cartilages and the cartilaginous rings of the trachea and bronchi. Its nerve is the inferior laryngeal branch of the vagus. The vascular arches of the fifth arch probably disappear early. Those of the sixth persist. On the left side it forms part of the right pulmonary artery and the ductus arteriosus; on the right it shares in the formation of the right pulmonary artery.

The *muscles of the arches* deserve special consideration. At first they are limited to the area of their respective arches, but with the increase in



length of the neck of the embryo and the differentiation of different structures such as the tongue, palate and larynx, many of the muscles are carried into regions remote from their origin. As they always carry their nerves with them, we can distinguish the embryonic origins of all the muscles of the neck by their nerve supply. From the first arch (mandibular, fifth nerve) are derived the muscles of mastication, the myohyoid and the anterior belly of the digastric, the tensor palati and tensor tympani. From the *second arch* (hyoid—seventh nerve) are derived the stapedius, the stylohyoid, the posterior belly of the digastric, all the muscles of facial expression and the platysma. From the *third arch* (ninth nerve) are derived the stylopharyngeus and some of the muscles of the soft palate. From the *fourth arch* (superior laryngeal

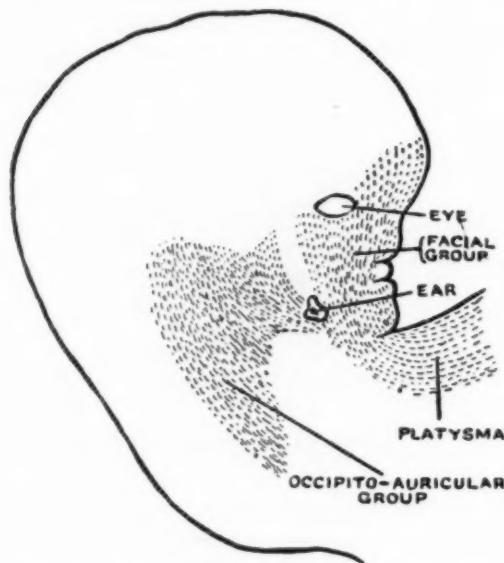


FIG. 4.—(From Keith's Human Embryology.) The expansion and migration of the platysma sheet in a human embryo of six weeks.

nerve) are derived some of the muscles of the soft palate, the constrictors of the pharynx and the cricothyroid. From the *fifth arch* (inferior laryngeal nerve) are derived the intrinsic muscles of the larynx.

Great irregularity is shown in the movement or migration of these muscles, and this is strikingly exemplified in the soft palate where one of the muscles (tensor palati, fifth nerve) is derived from the first arch, while the rest are derived from the third and fourth arches (ninth and tenth nerves). The most extensive migration is seen in the muscles derived from the second arch (hyoid) (Fig. 4). A remarkable muscular bud makes its appearance which grows upwards into the face and scalp over the surface of the first arch and downwards into the neck over the surfaces of the posterior arches. From it the occipitofrontalis, all the muscles of expression and the

## RANULA AND BRANCHIO-GENETIC CYSTS

platysma are derived. The branches of the seventh nerve carried with these muscles identify their origin.

To these disturbing agents in the orderly arrangement of parts is added another muscular migration which arises in the seventh, eighth and ninth body segments which are situated behind those supplied by the tenth and

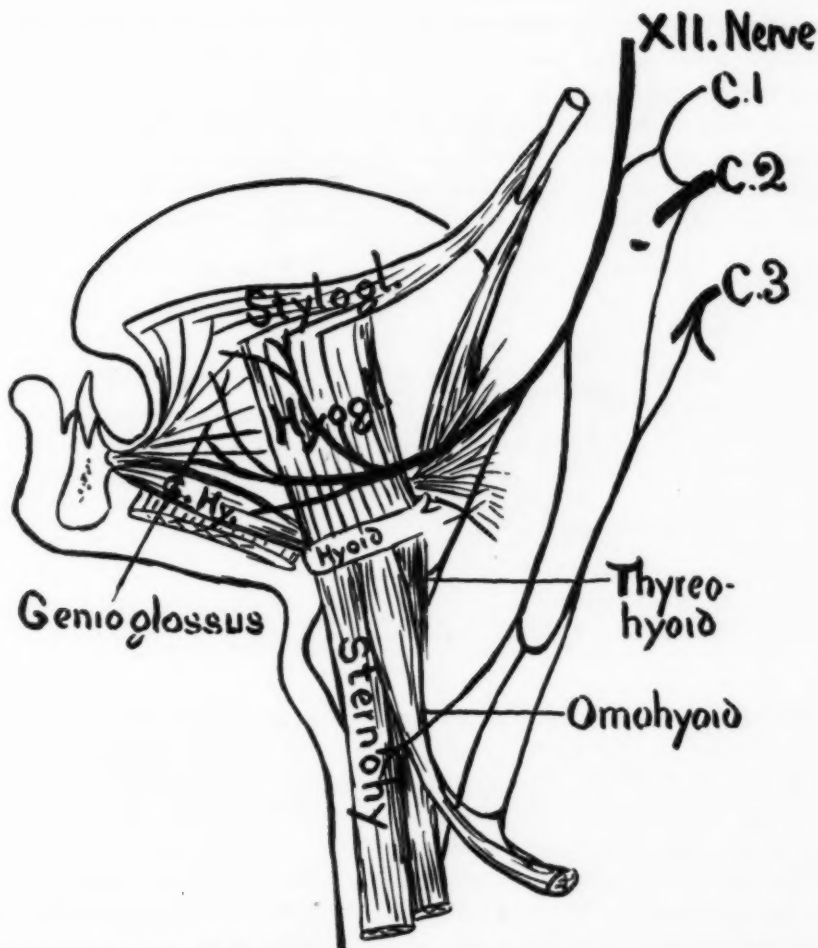


FIG. 5.—(Original V. K.) Modified from Cunningham. Showing the muscles supplied by the hypoglossal nerve (XII) to illustrate the migration of the muscles derived from the seventh, eighth and ninth body segments. It must be noted that the infrahyoid muscles are probably derived from the cervical segments behind the hypoglossus group.

eleventh nerves (Fig. 5). These segments are supplied by the twelfth nerve (hypoglossal). The path and extent of this migration is clearly indicated by the course of the hypoglossal nerve and the situation of the muscles supplied by it. It may be divided into two parts: an upper (lingual) from which the geniohyoid, the geniohyoglossus, hyoglossus and all the intrinsic muscles of the tongue are derived; and a lower (infrahyoid) which forms

the depressors of the hyoid bone. One of these muscles, the omohyoid, extends downwards as far as the scapula. The actual path of migration of the upper (lingual) division is charted accurately by the course of the main trunk of the hypoglossal nerve. The descendens hypoglossi is a similar guide to that of the lower division. The upper muscular division penetrates into a bud of hypoblast which is situated on the posterior surface of the fused anterior ends of the first, second, and third arches. This bud, called the lingual bud, is developed from two separate parts (Fig. 6), an anterior (buccal) which arises from the anterior ends of the first visceral arch (tuberculum impar), and a posterior (pharyngeal) which arises from the anterior ends of the second and third arches. The epithelium covering these buds retains its original nerve supply. That to the anterior which forms the anterior two-thirds of the tongue comes from the nerve to the first arch (fifth lingual), while that to the posterior which forms the posterior third

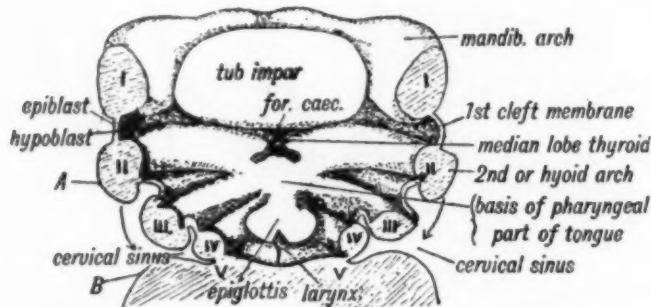


FIG. 6.—(From Keith.) The floor of the pharynx in a human embryo of the fourth week. Five branchial arches are shown separated by cleft depressions. The early stages of the development of the cervical sinus are shown; also the separate hypoblastic eminences that form the anterior and posterior parts of the tongue.

of the organ is derived from the nerves of the second and third arches and is represented by the chorda tympani (seventh) and the glossopharyngeal (ninth). The resulting organ offers an interesting picture of a muscular mass innervated by the twelfth nerve and covered by mucous membrane supplied by the fifth, seventh and ninth nerves.

The muscular migrations have been described in some detail because our final argument is based on the hypothesis that they are responsible for carrying cysts from one region of the neck to the other.

#### BRANCHIAL CLEFTS

Four cleft depressions can be recognized in the embryo. The *first cleft* (hyomandibular) persists. Its external depression is represented by the external auditory meatus. In connection with the internal depression the Eustachian tube and the tympanum are developed. The membrana tympani is supposed to represent the cleft membrane. The second, third and fourth clefts disappear and usually leave no trace of their existence. In a very

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young embryo (fourth week) the second arch (hyoid) grows downwards and covers the third and fourth and comes into contact and fuses with the body wall behind the fifth. By this growth, which is analogous to that forming the gill covers of fishes, the orifices of the second, third and fourth cleft depressions are covered up and a space is shut off into which they open. This is called the "*cervical sinus*." A knowledge of the ultimate fate of the cervical sinus is of fundamental importance in explaining the characteristics of branchiogenetic cysts. Under normal conditions it disappears. If it persists a cyst or a fistula may result. The sinus may open externally on

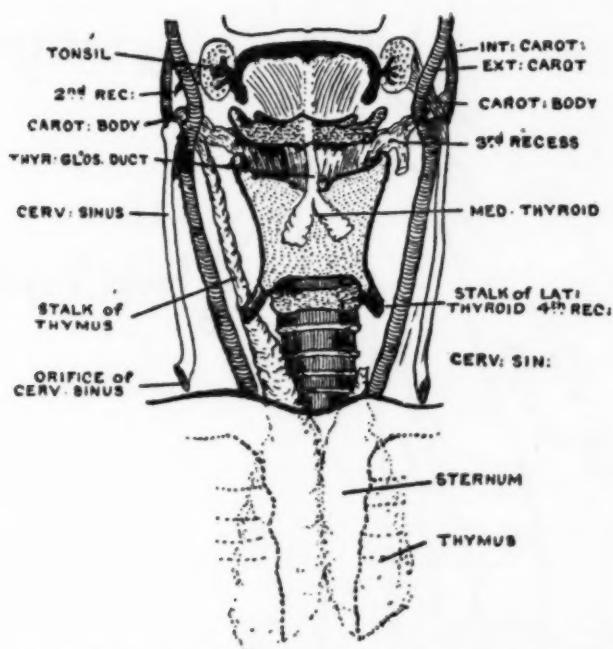


FIG. 7.—(From Keith's Human Embryology.) A diagrammatic representation of the structures developed in connection with the inner cleft recesses. Note on the right side of the figure a branchial fistula due to perforation of the second branchial cleft and persistence of the cervical sinus. This figure should be studied in connection with Figs. 8 and 9.

to the neck or internally into the pharynx. The external opening is invariably along the line of the anterior border of the sternomastoid muscle. It may be placed anywhere between the angle of the jaw and the sternal notch, but it is usually about the middle of the neck. When an internal opening is present it is usually due to perforation of the second cleft membrane, and the pharyngeal orifice is situated in the tonsillar crypt (Fig. 7). Internal openings due to perforation of the third and fourth cleft membranes are infrequently seen. The pharyngeal orifices of these openings are situated lower down in the sinus pyriformis. The tracks leading from the cervical sinus into the pharynx through the membranes of the second, third and fourth clefts would in the adult neck course in widely diverse directions. That pass-

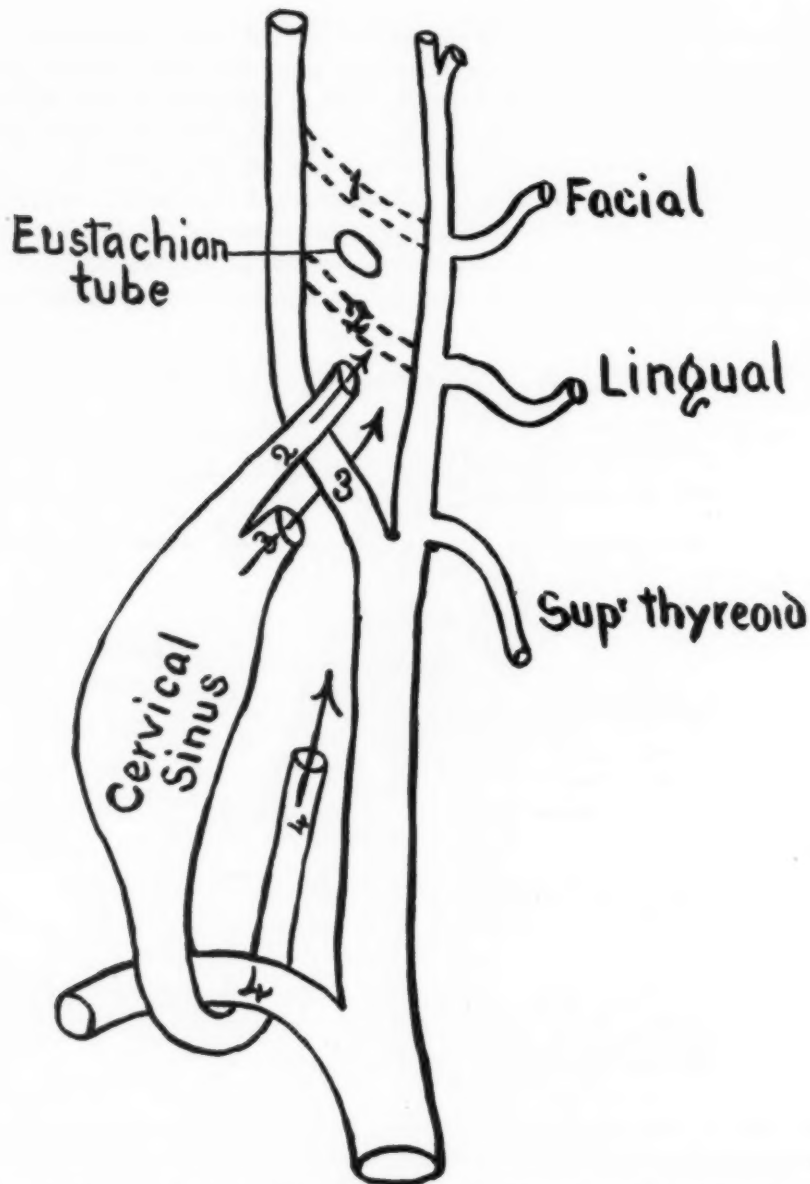


FIG. 8.—(Original W. K.) A diagrammatic representation of the cervical sinus to show the anatomical paths which would be taken by fistulous passages passing through persistent second, third and fourth clefts. This figure shows the relationships of these fistulae to the vascular arches of the neck. The large figures are on the vascular arches; 2 is on an obliterated trunk; 3 is on the commencement of internal carotid; 4 is on the right subclavian. The smaller figures near the arrows are on the fistulous tracks. Note that track 3 passes below the fork of the carotids and track 4 passes below the subclavian artery (right side).

ing through the second cleft always courses upwards between the arch of the carotid arteries and penetrates the pharyngeal muscles above the glossopharyngeal nerve; that passing through the third cleft courses upwards below the in-



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ternal carotid, above the superior laryngeal nerve and below the glossopharyngeal nerve; that passing through the fourth cleft must pass downwards, hook around the subclavian artery on the right side and the aorta on the left and course upwards alongside the inferior laryngeal nerve. When both internal and external openings are present a fistulous track passes from the surface of the neck to the pharynx. When there are neither internal nor external openings present, but the sinus persists either in whole or in part, a cyst results. In Figs. 8 and 9 an attempt has been made to show in a diagrammatic

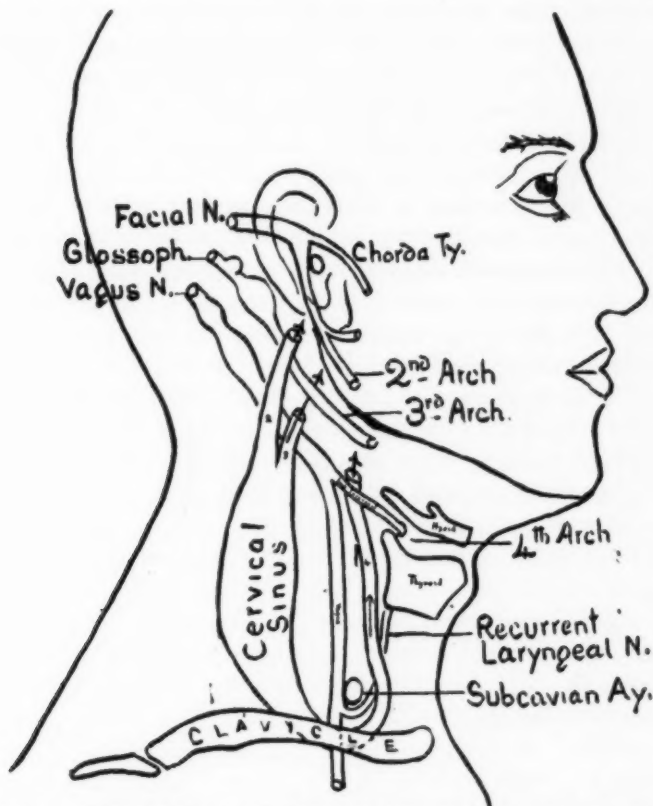


FIG. 9.—(Original W. K.) A complementary picture to Fig. 8 to show the anatomical relationships of persistent branchial fistulae to the nerves of the neck. Arrows are placed in the fistulous tracks leading from the cervical sinus. Note that track 3 passes beneath the glossopharyngeal nerve and above the superior laryngeal branch of the vagus; also that track 4 passes downward below the subclavian artery (right side).

manner the relationships of the fistulous tracks of branchial origin with the nerves and arteries of the branchial arches. A careful study of these plates will convince us that the description of the fistulae in question has hitherto been very loose and inaccurate. This is particularly the case with those due to the persistence of the third and fourth clefts. The statement that a fistula due to the persistence of the cervical sinus always passes upwards between the fork formed by the external and internal carotids,

can only be true on strict embryological grounds when the second branchial cleft persists. That almost all fistulous tracks take this direction is absolute proof of the persistence of this cleft in the great majority of cases. Too few careful records of dissection are available to enable us to speak authoritatively as to the frequency with which the third cleft persists; while I am not acquainted with any observation showing a fistulous track passing around the subclavian artery or the aorta, the only possible route when the fourth cleft persists.

There is abundant evidence to justify us in attributing lateral cysts and fistulae situated in the middle of the neck, to the persistence of the cervical sinus and the branchial clefts. But it is more difficult to explain how cysts situated close to the base of the skull and those in the submaxillary and lingual regions can be derived from the same source. It will be conceded that the cysts under consideration conform to the type of branchio-genetic cysts in anatomical structure and contents. Therefore, the difficulty in accepting them as truly branchio-genetic will disappear if a satisfactory explanation can be offered as to the manner in which they are carried from their original location, and disintegrated into two or three separate fragments. It appears to me, if we admit the possibility of these cysts being carried from a lower level to a higher by muscular agency in the rearrangement of the muscular planes of the neck, that the problem is easily solved. After due deliberation I have adopted the theory that ranula, submaxillary cyst and deep cervical cyst of the type described, are derived from the cervical sinus which has been carried from its original position by the muscles of the branchial arches and those of the hypoglossal segments during the process of their migration. On this theory the deep cervical cyst which has such characteristic anatomical boundaries would be carried upwards by the palate muscles, all of which except the tensor palati (first arch) are derived from the third and fourth arches, whereas the cysts found in the submaxillary and lingual regions would be carried upwards by the muscles of the tongue derived from the hypoglossal group which belongs to the seventh, eighth, and ninth body segments.

## LATE RESULTS AFTER THE RADICAL OPERATION FOR CANCER OF THE BREAST \*

BY WILLY MEYER, M.D.  
OF NEW YORK, N. Y.

LAST fall, when preparing the data for a clinic I intended to hold during the Congress of American Surgeons in this city (October, 1919) on late results of operation for the radical cure of cancer of the breast, I tried to reach all my former ward patients, but soon was obliged to give up the efforts in this direction. It proved absolutely impossible—with the ever-shifting population of a large city like New York—to trace the patients operated upon in the wards.

This experience again impressed me with the great desirability, nay, necessity, of the "Follow-up System" so auspiciously inaugurated by a number of large hospitals in our country.

Under the circumstances I was obliged to content myself with the data available from my private patients, whom I had personally followed up for the last twenty-six years.

Two radical operations have been before the profession since the fall of 1894. Their principal point of difference is the direction in which the surgeon proceeds. The one method starts from the chest and works toward the axilla, leaving the clavicular portion of the pectoralis major behind; it requires entering the space between pectoralis major and minor muscles; the latter usually is divided and then sutured. As a matter of necessity this method involves quite some loss of blood.

The other method, which I have practised since September 12, 1894, starts from the axilla and works toward the sternum. The tendons of pectoralis major and minor are divided in the early stage of the operation, necessitating complete excision of both muscles. Blood- and lymph-vessels are primarily divided within the axilla. The lymph-nodes and axillary fat are lifted out in connection with the tumor, before the cancerous breast itself is handled. The entire mass is removed without entering what I call the "infected area." Hemorrhage is reduced to a minimum.

The final results of the operation from the sternum toward the shoulder, as reported, have been good. Still small cancerous glands have repeatedly been found between pectoralis major and minor muscle, and where cancerous lymphatic glands have developed there must be present suspicious lymphatic vessels. I feel that it must be better for

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\* Remarks made at the Joint Meeting of the New York Surgical Society and Philadelphia Academy of Surgery, February 3, 1920, and before the Surgical Section of the New York Academy of Medicine, April 2, 1920.

the patient if the space between the two muscles is not entered and the entire diseased area is excised in its normal anatomical relation.

Previous to 1894 excision of the breast for carcinoma was at last done in two stages, but at the same sitting, first, the removal of the breast with axillary contents; then the excision of the pectoralis major muscle. This arrangement forced the surgeon to widely enter "the infected area" and caused an unnecessarily great loss of blood. Personally, I did not see a single lasting cure after this mode of advance. The radical operation changed the results with one stroke. Most forcibly was this brought home to me by comparison of my personal statistics before and after September, 1894. The first two cases subjected to the modern radical operation were completely cured, and Case IV of this series had enjoyed freedom from cancerous recurrence for many years when she died of old age.

The following personal cases are alive and well to-day, from twelve to twenty-five and one-half years after operation:

CASE I.—Operated upon September 12, 1894, when thirty-eight years of age (now a lady sixty-four years old). It is the first case operated upon by the method outlined above. She is alive and well to-day, twenty-five and one-half years after operation (Fig. 1).

CASE II.—Operation done in 1895, at the age of forty-eight years (now a lady seventy-three and one-half years old). The patient is alive and well to-day, twenty-five years after operation (Fig. 2).

CASE III.—Operation in July, 1902, when thirty-three years old (now a lady of fifty-one years). Patient alive and well to-day, eighteen years after operation (Fig. 3).

CASE IV.—Operation in December, 1903, at the age of thirty-six years (now a lady of fifty-three), perfectly healthy and free from recurrence to-day, seventeen years after operation (Fig. 4).

CASE V.—Operation in July, 1908, at the age of thirty-five years (now a lady of forty-seven years of age), perfectly healthy to-day, twelve years after operation (Fig. 5).

All patients have the full use of their arm, and are able to assume the posture of the "Statue of Liberty."

CASE VI (Fig. 6).—Operated upon in September, 1917; is added merely to show the present line of incision with Handley's addition down to a point midway between umbilicus and xiphoid process, for the excision of the fascia covering the upper portion of the recti muscles, in conjunction with the other mass. I consider this addition decidedly recommendable, because it makes the operation more radical and usually enables us to close the wound without grafting.

Five other cases have remained free from recurrence for four, six, eight (2), and sixteen years, respectively, and then died of other diseases.

Another patient, a pronounced diabetic at the time of operation, was well for six years after the same when she succumbed to the diabetes, without having developed any signs of a recurrence of cancer.

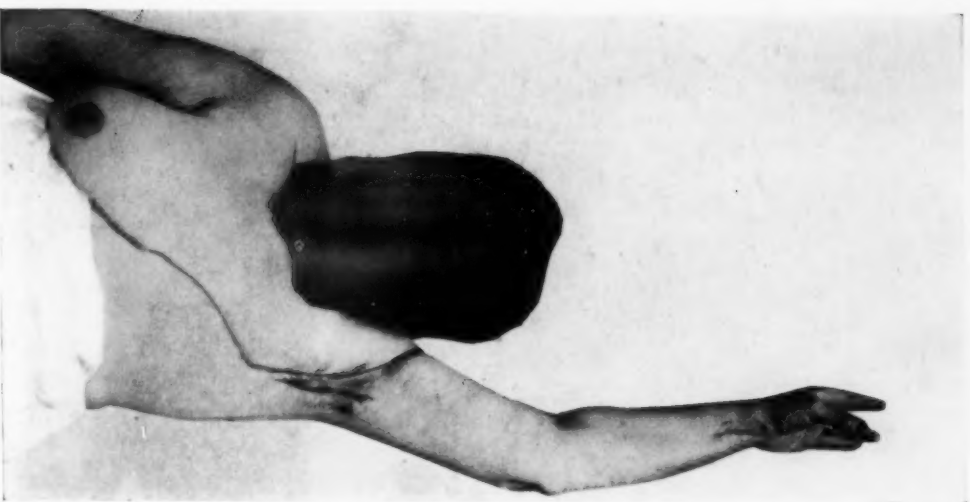


FIG. 1.—Mrs. M. O., now sixty-four years of age; operation, 1894.

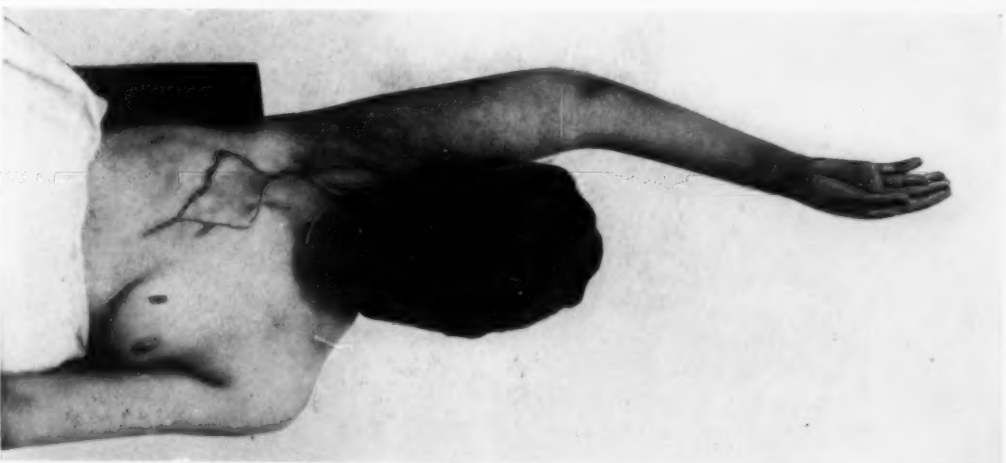


FIG. 2.—Miss I. S., now seventy-three and a half years of age; operation, 1895.

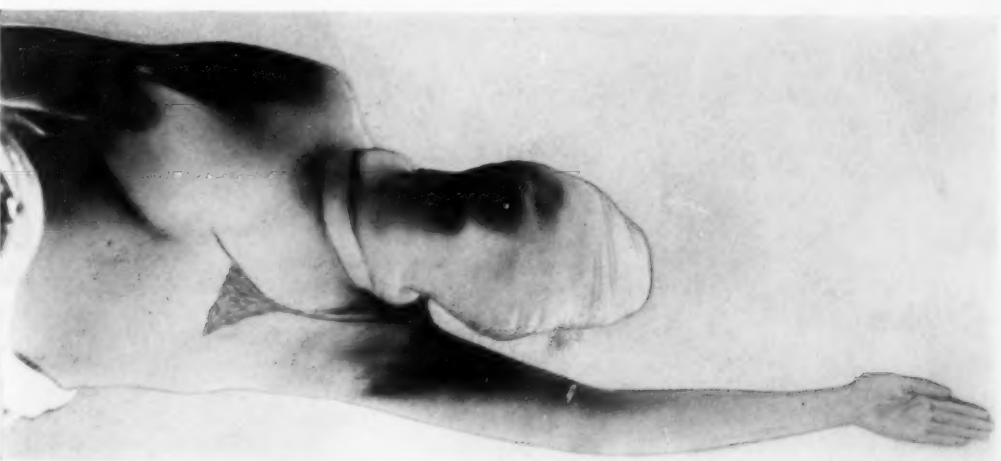


FIG. 3.—Mrs. H. B., now fifty-one years of age; operation, 1902.



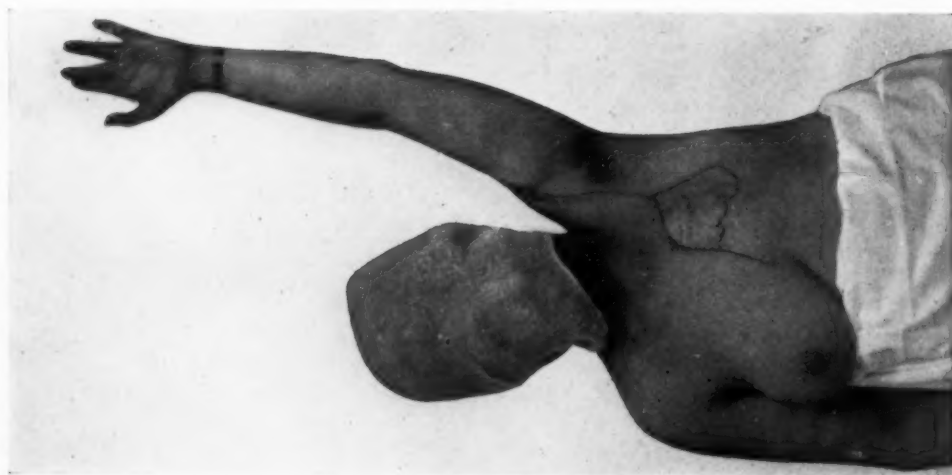


FIG. 4.—Mrs. J. W., now fifty-three years old; operation, 1903.

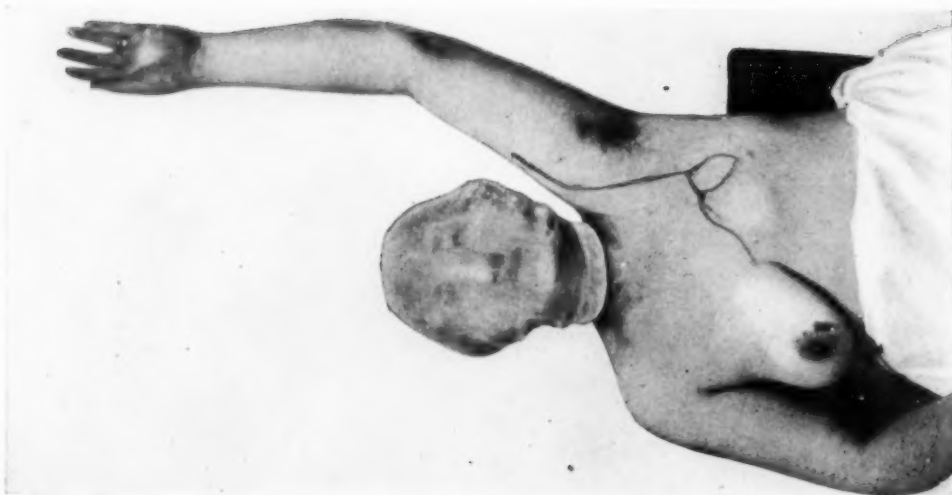


FIG. 5.—Mrs. E. H., now forty-seven years old; operation, 1908.



FIG. 6.—Mrs. C. J. Operation, November, 1917.

# Cancer

## "TOURNIQUET OPERATION" IN GOITRES

Still another patient, operated upon for cancer of the right breast in March, 1899, returned to me in December, 1900, with a carcinoma of the left breast, which I then also extirpated. She was well and free from recurrence when last heard from, in the spring of 1907, six and one-quarter years after the second operation.

A few days ago, I met a lady, now almost eighty years old, in perfect health, who had been operated upon by me for a scirrhus of the breast at the age of seventy-three years (seven years ago).

These results, to my mind, prove the efficiency of the method; they prove that the *radical operation for cancer of the breast can cure* patients thus afflicted. If not all cases are saved, this is due:

1. To the stage of the disease in which the patients reach the surgeon;
2. To the virulence of the agent that produces carcinoma.

*Paget's Disease (Epithelioma of the Nipple).*—In this connection I will not fail to say a few words regarding Paget's disease, this most malignant of all cancers of the breast known to us. If ever early and radical operation is imperative, it is in these cases, as will be seen from the following three observations which I made in the last two years.

CASE I.—Female, aged thirty years, mother of five children, had been in the hands of a quack and had been treated by caustics. When I saw her in January, 1918, the disease in the breast and axilla had far advanced. After the radical operation, the other breast soon became affected and, one year later, also was excised. Then, not long after, the disease became disseminated and she died from cancer en cuirasse.

CASE II.—Female, aged thirty-eight years, had been in the hands of one of our best X-ray specialists in the city. One and a half years after the cure of the nipple by radium treatment there was a local recurrence and a very extensive cancer of the breast with infected glands in the axilla and along the subclavian vein. Radical operation, done by me December, 1918, followed by renewed X-ray and radium treatment. She now has developed intrathoracic metastases.

CASE III.—Male, aged forty-five years. He had been in the hands of an experienced surgeon who had extirpated the breast only, without axillary glands, evidently because none could be found at that time. One and three-quarter years later the patient presented a far-advanced carcinoma. The radical operation then performed could not save him; he died from general metastases eight months later.

In operating upon mammary carcinoma, I make it a point to circumcise the skin widely at the base of the breast. I prepare two ample flaps and enfold them extensively, then divide the fasciæ at the base of the two flaps and extirpate them together with the mass.

I do not think that involvement of the supraclavicular glands presents a contra-indication to operation; on the contrary, I consider it the

## WILLY MEYER

surgeon's duty to operate when these glands are infected. Halsted, as well as the late Rodman, also Perthes abroad, have observed cases that remained well for a number of years after the extirpation of these glands.

In none of the cases who have remained well from twelve to twenty-five and one-half years after operation, were the supraclavicular glands found infected at the time of the operation, and, hence, they were not removed.

Personally, I have not operated upon a single case in which there were no infiltrated axillary glands.

As I have stated in a previous paper, to my mind statistics regarding the results of the radical operation for cancer of the breast are worthless. They do not prove anything. What *does* determine the fate of the patients is the so-called virulence of the disease. One and the same surgeon may do an equally radical operation in two seemingly early or apparently equally far-advanced cases; and one may remain well and free from recurrence for, say, twenty-five years, while the other may develop a regional recurrence and metastases within a few months.

All we can say is that cancer, being a local disease in the beginning, may be cured by radical operation if done at an early stage.

## THE REQUIREMENTS OF TECHNIC IN OPERATIONS FOR CANCER OF THE BREAST.\*

BY JABEZ N. JACKSON, M.D.  
OF KANSAS CITY, MO.

THE primary object of any operation for cancer should be the permanent cure if possible, of that cancer. This purpose should never be lost sight of.

### ESSENTIAL PRINCIPLES

In the accomplishment of this purpose, two primary principles present themselves.

First: The operation must be sufficiently thorough to insure the complete removal of all probably infected tissues within the limits of reasonable surgical access.

Second: Dissemination of the infection during the operation must be guarded against; likewise contamination of the wound with liberated cancer cells which may be left to regraft the disease.

In the evolution of a surgery which will fulfil these demands in cancer of the breast, the pioneer work of American surgeons, such as our fellows Professor Halstead and Willy Meyer, has largely blazed the way. Their work, based on accurate knowledge of the pathology of cancer and its routes of extension, supplemented by the later studies of the English surgeon, Handley, has pretty well standardized the extent of resection required.

EXTENT OF OPERATION.—The standard excision of to-day, therefore, involves the following:

1. *Skin*.—A wide area of skin covering the breast. In this respect American surgeons are inclined to go rather farther than the English. Many insist on a complete removal of the entire skin over the mammary gland. The English surgeons, as a rule, demand less skin removal, but insist on an extensive deeper resection. At least a wide area surrounding the underlying focus of infection must be removed. With present methods, complete ablation can be followed with equally satisfactory subsequent management.

2. *Mammary Gland*.—The entire mammary gland must, of course, be removed. It is well to remember that there are often outlying lobes, and these must not be overlooked.

3. *Pectoral Muscles*.—It has been pretty fully demonstrated that lymph vessels containing cancer cells may be found running through the pectoralis major muscle and between the two pectorals. These muscles should, therefore, be included in the ablation. The clavicle portion of the pectoralis major is probably free from suspicion, and, for good reason, is by many not sacrificed. Its retention particularly saves a very trouble-

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\* Read before the American Surgical Association, May 5, 1920.

some vacant space just below the clavicle, which is hard to obliterate, and causes tedious convalescence. Some divide the pectoralis minor for axillary dissection and then resuture. We are unable to note any disadvantage to the patient in its absence, and its removal makes clean axillary dissection much better.

4. *Axillary Glands, Fat and Fascia.*—All lymph-bearing structures from the axillary fossa requires clean and complete dissection. After the pectoral muscles have been divided and retracted, an incision to the outer side and parallel to the axillary vessels and nerves divides the loose fascia down to the line of cleavage of these structures. Then dissection on this plane inward clears them completely of all fat, fascia and glands. This clearing is carried high up beneath the clavicle towards the subclavian vessels and supraclavicular space. Branches from the axillary vessels are clamped close to their origin and divided, thus enabling one to make a complete dissection. This tissue clearing is continued down the under side of the scapula until the subscapular muscle stands out clearly and below and posteriorly the latissimus dorsi. Likewise the thoracic wall is cleared of all loose tissue, including the pectoral muscle above, leaving the ribs and intercostal muscles bare. This muscle and fascia clearing runs quite to the median line.

5. *Supraclavicular Space.*—Some surgeons, as routine, make a similar clearing of the subclavian triangle above the clavicle. We believe this adds little to safety, and perhaps much to embarrassment. We prefer the post-operative raying of these areas.

6. *Abdominal Fascia.*—Handley claims that metastatic spread is largely along fascial planes, and that by this route the abdomen is reached. Hence he advises further the removal of the fascia of the rectus on the side involved, down to the umbilicus, and in part the corresponding fascia of the external oblique. We have done this in certain cases, but do not believe the practice has become general with American surgeons as yet.

DISSEMINATION AND CONTAMINATION.—In operating we must further remember that *dissemination* may take place during the operation through uncut lymphatics, or *contamination* of the wound may occur with cancer cells escaping from cut lymphatics.

*Dissemination* may occur by milking the lymphatics in the manipulation of the infected breast during operation. Manipulation or squeezing of the breast should, therefore, be carefully avoided. More important, however, in preventing this complication is the suggestion, original, we believe, with Willy Meyer, to begin work in the axilla, dividing the lymph vessels at their highest point before the breast is handled at all. Thus the routes of dissemination are cut off. We go further and completely circumscribe the breast in our primary dissection, early dividing as well the pectoralis major at its sternal attachment, so as to cut off the route of



## CANCER OF THE BREAST

dissemination through the chest wall into the thorax. The breast itself is therefore not handled at all until its peripheral zone has been completely shut off from its lymphatic connections.

*Contamination.*—We are also of the opinion that perhaps many of the cases of local recurrence are due to cancer cells escaping from the cut lymphatic vessels during the operation. These implanted in the wound after its closure serve as grafts, which in their home soil readily develop into new growths. While this idea is not demonstrable, it is at least thoroughly plausible. To prevent such contamination we are wont to utilize two resources. *First:* Incision at the outset is made complete as planned, and the flaps on all sides which remain are dissected up to the extent required. They are at once covered with hot gauze pads to protect their surface from contact of escaping cells. As the dissection proceeds, we extend the process of gauze protection, covering both the area of the wound to remain, and as well the cut surfaces of the ablated breast to prevent the escape into the wound of the cells from divided lymphatics. *Second:* Fearing that despite these precautions there may yet occur contamination, we thoroughly irrigate the wound before suturing, with a stream of water of some force, accompanied by light mopping with gauze. In our experience, local external recurrences are rare, and we feel that perhaps these precautions have aided in the results.

### SECONDARY CONSIDERATIONS

Admitting the fulfillment of the above essentials in the details of operative technic, looking to the primary object of the cure of cancer, an ideal surgical procedure yet involves other considerations. We know that of all factors of success, an early operation is the best possible promise of a permanent cure. Surgery must, therefore, win women to the idea of an early operation. In considering this purpose we must recognize the psychological and utilitarian aspects of surgery. Surgery must be made as attractive as possible, or perhaps better expressed, less repulsive. We have seen many results in the past in which this aspect of the case was not impressive. An arm disabled, with contracting and binding scars (which rendered it almost useless); long and tedious wound healing, with prolonged hospital stay and mounting hospital expenses—sapping the oftentimes limited financial resources; repulsive scars from excessive skin grafting, with ribs showing through and the heart beats almost visible; is it remarkable that with these pictures shown in their friends, women should shrink from surgery in their own needs? Our results in cancer are not brilliant at best, but they are the best that science offers up to date. As surgical results we can probably only improve them through universal resort to early operation. We must, therefore, bend our efforts to make the primary results of surgery at least as attractive as possible.

Of these utilitarian and psychological factors, that of first importance is the preservation of a good function of the arm.

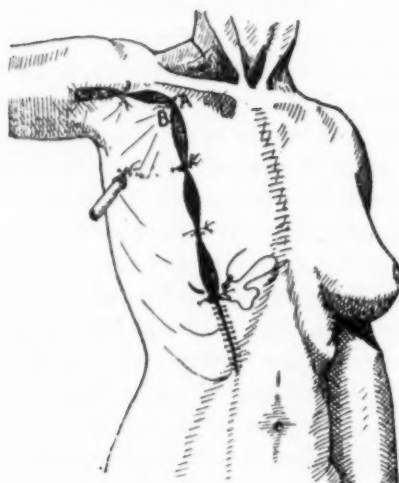
*Preservation of Function.*—Painless, free, unrestricted movements of

the arm constitute good function. Excess of scar tissue or improper placement are the chief factors producing disability. To prevent these troubles, several points should be observed.



No. 1.

FIG. 7.—Incision of new method, meeting demands in certain cases.



No. 2.

FIG. 8.—Illustrating method of closure.

*First.*—The line of scar should not run transversely from arm to chest. If it does, the inevitable contraction of scar tissue is inclined to draw the arm towards the chest and prevent full elevation, abduction, and external rotation. A line of suture running in the long axis of the arm up to the

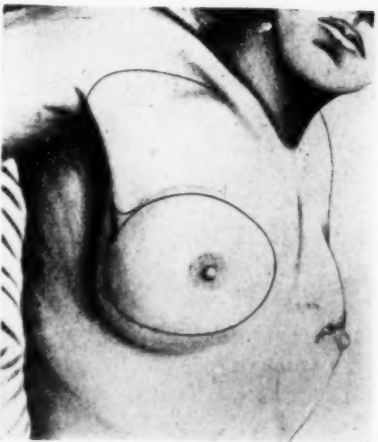


FIG. 1.—Outline of incision, marked with a scratch stroke of the knife, in author's original operation.



FIG. 2.—Quadrilateral flap of the skin and super-facial fascia stretched out by tenaculum forceps and transferred inward to cover defect created by removal of skin and breast.

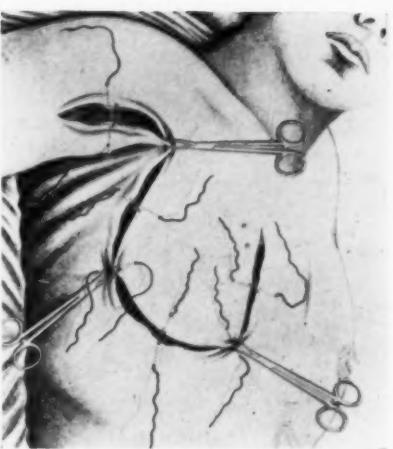


FIG. 3.—Method of insertion of figure-of-eight coaptation sutures.



FIG. 4.—Flap sutured in place, with drainage-tube inserted.



FIG. 5.—Photograph illustrating exact method of mapping out flap in author's original method.

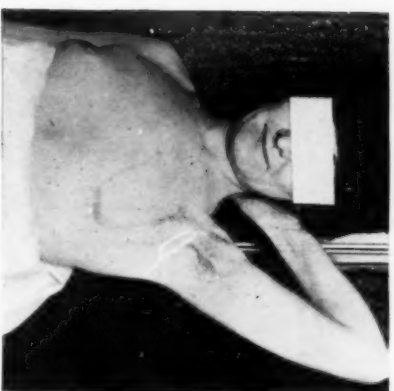


FIG. 6.—Demonstrating unrestricted use of arm and relation of scar to the arm when thus used.



FIG. 9.—New method immediately after closure with position of placement of arm. Photograph likewise shows stab wounds to insure drainage of venous engorgement of flap.



FIG. 10.—Showing complete elevation of arm one week after operation.



FIG. 11.—Position of arms two weeks after operation. At this time mobility was complete and voluntary, as illustrated. Author's new method.



FIG. 12.—Position of arms two weeks after operation. At this time mobility was complete and voluntary, as illustrated. Author's new method.

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level of the shoulder-joint and then on to the chest, would appear ideal.

*Second.*—The proper obliteration of the emptied axillary fossa presents a problem. Unless satisfactorily accomplished, the large cavity must be finally obliterated by organization of new tissue with scar formation, which further restricts mobility. What may be even more troublesome to the patient is the compression by such scar tissue of the brachial plexus, with much ensuing pain, or the compression of axillary vessels with impairment of circulation. A paper by our lamented Murphy, presented before the Western Surgical Society in 1904, emphasized these particular points. As a corrective, he advised leaving a flap from the lower border and outer end of the pectoralis major muscle, which was carried closely around the axillary structures and sutured to protect these from scar contractures. To us it seemed that this expedient was subject to criticism in that it left the portion of this muscle likely to be infected. Endeavoring to meet the obvious demands in a better manner led to our original work on this subject, which evolved the technic which we presented to the Western Surgical Society in December, 1905, and published in the *Journal of the American Medical Association*, March 3, 1906.

The complete obliteration of the axilla fossa, by bringing the skin from the under side of the pectoralis major, or the floor of the axilla, up to a longitudinal incision in the line of the arm, covered these vessels snugly and we consider it the chief value of that technic. When this was done in this way, we found the skin covering the front of the pectoral fold lax, and rather accidentally we slid it over to cover the area of the breast excision, and thus the flap evolved. While the flap proved an aid in covering the area of denudation, and this contributed to the value of the operation, the chief virtue sought and developed was in placing the scar line properly and in readily obliterating the axillary fossa.

*Third.*—In the rapid restoration of function we have found another expedient valuable. If the case is dressed after the operation with the arm down to the side, we find it hard to get a timid patient to raise, abduct or externally rotate the arm. They are thus very slow in being educated to get the arm upward or backward, and hence are unable to dress their hair or otherwise wait upon themselves. To remedy this we have from the outset kept the arm up at right angles to the trunk. They are put to bed with the arm in this position; then early passive motion is begun, while between times the arm is kept up. With our method there is no tension even with the arm in this extreme abduction, and rapid improvement in arm function is pronounced.

*Short Convalescence.*—Methods which insure prompt wound healing, and correspondingly shorten convalescence, save time and hospital expense—both matters oftentimes of much concern. These indications are best met by methods which permit *primary closure* of the wound without undue tension and primary union. It is remarkable how much can be done to facilitate suture by proper under cutting in dissecting up the flaps in any



operation. With a wide skin removal, however, this can in some cases not be accomplished except by some *plastic method*. To these plastic methods some have objected, saying: "When one seeks to close a wound at the end of his operation, he will probably not be radical enough in the operation." If this were true, there would be nothing to say. But on the contrary, it is much more probable that a surgeon will do a radical operation *always* if he is possessed of resources which still permit closure without tension and primary union in most cases.

In either plastic flaps or undermined flaps we will sometimes have inadequate terminal vessel supply for every inch of skin margin, and hence there may be some small area of consequent necrosis. These areas when present are small. In many instances they result from venous engagement with secondary capillary compression and obstructions. *Multiple* small *stabs* scattered over the flap will permit drainage of venous engagement and obviate these areas of gangrene quite decidedly. It is a small point, but worth noting.

*Cosmetics*.—Finally, of the minor factors is that of cosmetics. Women are naturally quite sensitive of their person. A disfiguring scar produces repulsion and horror both in the individual as well as in other women who see it. A wound covered by a skin graft is certainly not a thing of beauty at best, and may be a determining factor in keeping others from needed surgical attention. We believe that in the present day, with methods available, skin grafting should almost never be necessary.

*AUTHOR'S OPERATIONS.—First Method*.—In meeting all these requirements of an ideal operation in cancer of the breast, after nearly fifteen years' experience with it, we yet believe the method we first published in 1906 comes more nearly serving than any we know. In detail of technic there have been several changes noted in the preceding lines, and we will not enter into any further description than may be obvious from the pictures herewith presented, supplementing the former article. Theoretically it has been perhaps criticised, as are all plastics, that in seeking closure infected tissues are left behind. On the contrary, we do a more radical operation than any we have witnessed in other clinics, and do so because we know we can yet secure easy closure. Perhaps it might be thought that the flap itself might be the site for local recurrences. In answer we might note that the skin which forms the flap is not removed in any described technic to our knowledge. We admit to having seen cases done elsewhere in which the flap had been apparently taken too far inward and came from the mammary region. But correct observance of our method discloses that the outer incision runs quite out to the deltoid and its inner parallel should be entirely outside of the mammary gland. In experience we have seen only two recurrences in the flap, and excision of the small nodules in both these cases showed that they had origin in the fascia of the chest and not in the tissues of the flap. Both of these experiences were in early cases, and we believe were due to con-

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tamination. Since employing the methods suggested we believe these recurrences will be rare at least. In fact, it has been rather noteworthy in our experience how rare have been external or so-called skin recurrences, and that in these instances, how immune the flap area had been. In fact, we believe the method readily applicable to all cases except in those of most extensive skin involvement, or in those rare cases in which the extension may be out on the skin over the anterior axillary fold itself.

*Second Method.*—In just such a case as this we were obliged to forego the flap entirely in a case about a year ago. We have remarked before that, after all, the flap is the least valuable feature of our operation. We found in this instance we were still able to preserve the more characteristic advantages of our original operation, and this method we wish briefly to present. The diagrams presented reveal the nature of the incision better than can be expressed in words. By this method all of the skin over the pectoral area as well as that of the mammary region is removed—a more radical skin removal than any heretofore presented. In closure of the wound, however, it is observed that the axillary fossa is obliterated exactly as in our first method. Likewise the scar in the long axis of the arm to above the shoulder and thence to the chest presents the same advantages of scar location to favor functional utility of arm. With the usual rather extensive undermining, we have found that even this large wound closes rather readily without practically any tension, and we have secured primary union in all cases. As a matter of fact, to prove it out we have employed this method in most of our cases in the past year, whether specially indicated or not. We find quite as good functional results. It does not present quite so attractive a cosmetic appearance.

## TRAUMATIC FAT NECROSIS OF THE FEMALE BREAST AND ITS DIFFERENTIATION FROM CARCINOMA \*

BY BURTON J. LEE, M.D.

AND

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OF NEW YORK, N. Y.

THE object of this report is briefly to set forth the clinical, operative, and pathological findings of two cases of traumatic fat necrosis of the breast, recently encountered at the Memorial Hospital. Although much has been written concerning the differentiation between the benign lesions and mammary carcinomata, a careful search of surgical and pathological literature has failed to reveal any reference to this subject, for it has apparently hitherto been unrecognized.

We have the hope that the data presented and the discussion stimulated by the study of these two cases may result in a better understanding of the clinical and pathological aspects of this subject and lead to its more accurate diagnosis in the future.

Clinically the simulation to carcinoma is very startling, and we desire to place special emphasis upon this point. In one of the cases, a radical amputation of the breast, muscles and axillary contents was performed, the operator believing that the tumor was malignant. In the other patient only local removal of the mass was practised, at first, but gross examination of the cross-section, in the operating room, led one of the writers to a diagnosis of carcinoma, which was confirmed by another surgeon, but not concurred in by a third. The breast was removed, but the muscles were not sacrificed. A more careful analysis of the gross and microscopic appearances made the real character of the lesion apparent.

**CASE I.—E. B.** The woman was a white, native-born American, aged fifty-two years, and was a widow. She was admitted to the Memorial Hospital August 29, 1919.

*Chief Complaint.*—A growing mass of considerable size in the right breast.

*Family History.*—Negative for carcinoma.

*Past History.*—Previous illnesses: She was operated upon at the Memorial Hospital, six years previously, for an abscess of the right side of the neck. She had had several miscarriages. Her past history was otherwise negative.

*Breast History.*—She had had no lactations and there had never been any ailment with either breast.

*Present Illness.*—In May, 1919 (three months before her admission

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\* Read before the American Surgical Association, May 5, 1920.

## TRAUMATIC FAT NECROSIS OF THE FEMALE BREAST

to the hospital), she received a definite trauma to the right breast. This occurred while she was sitting in a street car. A woman carrying a child fell heavily against the patient, delivering a severe blow with her elbow against the right breast. This incident was not followed by tenderness or pain. Three months later (three days before her admission to the hospital) the patient noticed a lump, about the size of a lime, at the site of the former injury, in the upper outer quadrant of the right breast. This mass has been unassociated with pain.

*Physical Examination.*—The patient was a well-developed, well-nourished white woman, weighing about 190 pounds. Her general physical examination was negative, with the exception of the lungs, which showed on percussion slightly increased dulness between the scapulæ, together with a few scattered sibilant râles. Röntgen-ray examination of the chest showed no evidence of tuberculosis or metastasis. The Wassermann was twice reported negative.

*Breasts:* The mammary glands were of large type. A tumor was present in the upper outer quadrant of the right breast, measuring about 5 by 4 cm. There was no retraction of the nipple, nor was there any discharge from it. The mass showed moderate fixation to the skin, with some slight surface dimpling. There was some attachment to deeper structures. No axillary or supraclavicular nodes were palpable. The left breast was normal.

*Provisional Diagnosis.*—Primary carcinoma of the right breast.

*Operation.*—On September 23, 1919, the right breast, muscles, and axillary contents were removed by Doctor Bolling.

*Pathological Examination. Gross Examination.*—Three centimetres above and outside of the nipple situated in the breast was a tumor mass 2 cm. in diameter, irregular, circumscribed, but not encapsulated. It merged along one border with the fat tissue and elsewhere with the breast tissue. The tumor was opaque, brownish yellow, as in a xanthoma, and there was irregular hyperæmia along the upper edge. The growth lacked definite cicatricial character and chalky streaks.

The whole breast was uniformly fibrosed and contained no cysts. The axillary nodes were slightly enlarged and apparently not cancerous.

*Microscopic Examination.*—Sections showed broad areas of fat necrosis, surrounded by a broad zone of new cellular connective tissue, in which large vessels showed active obliterating endarteritis. Along certain segments of necrotic areas there was granulation tissue containing several large giant-cells. A search for spirochæte in the tissues was negative.

The patient was discharged from the hospital October 1, 1919, eight days after operation, having had an uneventful convalescence.

*Subsequent Notes.*—The patient was readmitted on November 10, 1919, because of persistent hemorrhage from the vagina. Examination revealed a small bleeding-point on an otherwise normal cervix. On either side of the vaginal vault were fungoid epithelial growths and half way down the posterior wall was another small tumor.

Sections taken from the vaginal growths were reported to be basal-celled carcinoma.

The patient was treated with radium by Doctor Bailey, and is still under his observation.

March 31, 1920, no evidence of disease in the vagina and cervix was apparent. The final outcome of the vaginal tumor will have to be subsequently reported.

Doctor Ewing has stated that the vaginal growth bears no relation of any sort to the traumatic fat necrosis of the breast, but these data are included as a part of the follow-up history of the case.

CASE II.—R. R. The woman was a Roumanian, aged thirty-six years and was married. She was admitted to the Memorial Hospital January 15, 1920.

*Chief Complaint.*—A lump in the right breast, which was steadily increasing in size.

*Family History.*—Negative for carcinoma and tuberculosis.

*Past History.*—Occupation: housework. Habits: abstemious. Weight: her usual weight was 211 pounds, and this was approximately her weight at admission.

*Previous Illnesses.*—She had always been well, with the exception of two extra-uterine gestations, both of which necessitated operative procedure.

She had never had any miscarriages.

Her past history was otherwise negative.

*Breast History.*—There had been three lactations: the first one fifteen years ago, the last one four years later, the duration of each having been about a year.

The nipples had always protruded.

There had never been any unusual breast incident during her nursing period.

*Present Illness.*—June 22, 1919 (about seven months before her admission to the hospital), her last operation for ectopic pregnancy was performed. Pleurisy and pneumonia developed and she became dangerously ill. She was given a hypodermoclysis under the right breast, three quarts of saline being introduced. No unusual pain was associated with this administration. One month later (six months before admission) she first accidentally noticed a small lump, the size of a walnut, in the upper and inner part of the right breast at the site of the previous injection. This mass had caused no pain whatever, but had been steadily increasing in size.

*Physical Examination.*—The patient was a robust, middle-aged woman, of unusually large build. Her appearance indicated perfect health. The general physical examination was negative. The lungs were clear throughout and fluoroscopy of the chest was negative.

Breasts: Large and pendulous. The left breast was normal.

The right breast showed no retraction of the nipple, nor was there any elevation of it. About 3 cm. to the inner side of the right nipple was a mass, 3 by 2 cm. in diameter, making it approximately the size of a small hen's egg. The tumor was roughly cylindrical, fairly sharply circumscribed, and had a distinct firm edge. The mass was hard in consistency. It lay just beneath the skin on the



## TRAUMATIC FAT NECROSIS OF THE FEMALE BREAST

upper inner aspect of the breast, near its posterior surface. The tumor showed slight skin adherence, but was, however, movable in the breast and not attached to deeper structures. There was one small soft lymph-node in the right axilla.

*Provisional Diagnosis.*—The provisional diagnosis was carcinoma of the breast, although the circumscribed character of the mass suggested the possibility of a benign adenoma.

*Pre-operative Treatment.*—The patient received the usual pre-operative Röntgen-ray cycle for the chest, breast, axillary and supra-clavicular regions, the cycle being completed on January 21st. Operation was performed nine days later.

*Operation.*—Under ether anæsthesia a local excision of the tumor was made through the anterior aspect of the breast, going well wide of the involved area. This local excision was done because the mass was so sharply defined that it seemed possible that malignancy might not be encountered. The tumor was immediately sectioned after its removal, and was found to consist of two sharply outlined solid areas, while between them lay a small cavity containing thick, oily fluid. As the knife passed through the solid tumor tissue one had the same impression of cutting a hard, granular substance that one experiences in sectioning a carcinoma. Although none of the minute yellow points so frequently seen in carcinoma could be distinguished, its extreme hardness made me feel fairly certain that the case was one of cancer of the breast. Another surgeon present concurred in this gross diagnosis. However, Doctor Stone did not believe the tumor was carcinomatous.

An amputation of the breast was then performed down to and including the fascia covering the pectoralis major muscle. The muscles themselves and the axilla were not disturbed. Further operative procedure was to depend upon the report of the pathologist.

*Post-operative Diagnosis (by the Operator).*—Carcinoma of the breast: Following the operation the operator was considerably concerned about the outcome of the case, having a fairly definite conviction that a more radical operation should have been performed. He was therefore very anxious to learn the result of the gross examination, anticipating criticism of the incompleteness of the operation. He was greatly surprised, however, to be told that the breast itself should not have been removed, that local excision of the tumor was all that had been indicated and that the lesion had no malignant features.

*Pathological Examination. Gross Examination.*—There was an indurated area, 2 by 1 by 4 cm., slightly cicatricial, not quite hard enough for carcinoma; well circumscribed, almost entirely encapsulated, apparently a fat lobule, which suggested a tumor process. On cross-section the texture was opaque, xanthematous and light yellow in color, not translucent, without definite chalky or silvery points. Adjoining was a smaller fat lobule, with a few similar slightly opaque points. Adjoining also was a cyst, 1 cm. wide, containing creamy contents, having a smooth blood-stained wall.

*Gross Diagnosis.*—Chronic inflammation in fat tissue. The remainder of the breast was normal.

*Microscopic Examination.*—The structure of the lesion showed chronic productive inflammation in fat tissue. There were no evidences of carcinoma. The fat-cells were proliferating, replacing fat, and many small giant-cells were present. There was much diffuse new fibrous tissue, which accounted for the opacity. In places there were collections of lymphocytes and occasionally a few cysts. The large cyst was lined by large epithelial cells of the sweat-gland type. A few accompanying breast alveoli showed round-cell infiltration.

There was no unusual incident in the patient's convalescence.

*Incidence.*—At the Memorial Hospital the ratio of traumatic fat necrosis of the breast to mammary carcinoma is as 2 to 330, or 0.6 per cent.

*Pathology.*—In our study of the pathology presented in these two cases we are greatly indebted to Dr. James Ewing, pathologist at Memorial Hospital, and he has outlined the following points in the gross examination of traumatic fat necrosis of the breast.

*Gross Appearances.*—The differential diagnosis of the gross lesions in these two cases presented an interesting problem. A careful study of the details of the naked-eye appearance led to the conclusion that in neither case was the lesion carcinomatous.

In the case of E. B. the presence of a rather large area of opaque discolored fat tissue, nearly diffuent in the centre, was satisfactory evidence that the chief material was necrotic fat. This area along one side was sharply demarcated from normal fat tissue, as is infiltrating mammary cancer; but this zone failed to show the positive signs of carcinoma, such as cicatricial contraction, grayish lustre, and fatty and chalky points and streaks. Likewise the rather broad zone 2 to 3 cm. of cellular granulation tissue did not present the form, outline, or texture of carcinoma. Accordingly, a gross diagnosis against a neoplastic process was rendered.

In the case of R. R. the gross diagnosis was more exacting, but was accomplished by careful adherence to the criteria of gross anatomical diagnosis of mammary cancer. Here there was one separate area, 2 by 2 cm., of necrotic fat, which was readily recognized. A second area presented greater difficulties. This was an oval area of 2 by 1 cm., firm and cicatricial in appearance, with exanthematous texture and considerably resembling carcinoma. However, it was observed that this area was fairly well encapsulated; that in size and form it was exactly similar to the adjoining fat lobules; and that it did not present the smooth opaque texture of carcinoma nor the chalky points or streaks. On these data the diagnosis of chronic inflammation of fat tissue was given. Paraffin sections revealed a productive inflammatory process with multiplication of many cuboidal fat-cells lying in alveoli, which would have been difficult to distinguish from alveolar carcinoma in a frozen section.

*Microscopical Appearances.*—Areas of necrosis in fat tissues were to be

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seen with new connective-tissue cells, growing in and about these areas of necrosis. This growth of new tissue was very abundant, and with the giant-cells which one saw scattered throughout the tissue a luetic granuloma might superficially be suggested. Many of the giant-cells were markedly flattened, the syncytial tissue being closely applied along the borders of huge vacuoles, which corresponded to large tissue spaces containing diffuent fat. These giant-cells were, therefore, of the so-called foreign-body type. Certain portions of the sections show proliferation of the nuclei of fat-cells, these same cells showing also an opaque zone close to the periphery of the cell, probably representing certain changes in fat saponification.

The blood-vessels show an obliterating endarteritis which was apparently of recent origin and a perivascular infiltration with lymphocytes.

*Diagnosis.*—Trauma appears to be an essential and distinctive etiologic factor in connection with fat necrosis of the breast. A history of the appearance of a mammary tumor with no preceding definite trauma would practically eliminate fat necrosis as a possible diagnosis. Although trauma is not infrequently encountered in the history of a mammary cancer, it is often indefinite and frequently absent. A recent exception to this rule was met in a young woman, aged twenty-six years, who received a terrific blow upon the breast by a hard-hit baseball. Six months later she developed, at the exact site of the injury, an encapsulated papillary cystadenocarcinoma of the breast. It is well known that this particular type of cancer is one of the less malignant varieties. In general, however, the surgeon should weigh carefully the evidence of distinct trauma to the breast and remember the possibility of a fat necrosis and the secondary chronic inflammatory changes attending it.

Clinically, traumatic fat necrosis of the breast very closely simulates mammary carcinoma and the differentiation may be very difficult. The symptoms of fat necrosis which strongly suggest malignancy may be enumerated as follows:

1. *Rapid Increase in Size.*—The mass of traumatized fat increases rapidly because of the proliferation of new connective tissue associated with the chronic inflammatory process. A period of several weeks or months may elapse from the time of the receipt of the injury to the appearance of the tumor; and from that time on the increase in size strongly suggests the possibility of malignancy.

2. *Skin Adhesions.*—Both the patients under report exhibited the same skin adherence which one sees in many cases of malignant disease of the breast. The tumor mass seemed held to the skin by several lines of adhesion and gave the impression of a solid tumor with superficial surface closely adherent to overlying skin. This feature so often regarded as pathognomonic for malignancy was striking in both instances.

3. *Consistency.*—The consistency of the tumor in each instance was as hard as in the average case of malignancy. Although some of the benign

fibro-adenomata are very hard, the two characteristics above mentioned are lacking in this type of growth. Upon the other hand, one must bear in mind the exceedingly soft, brain-like encapsulated carcinomata which are the most malignant of all types of mammary cancer. In general, hardness in a breast tumor suggests malignant possibilities, and traumatic fat necrosis with the reaction attending it produces a distinctly hard mass.

4. *Lack of Pain.*—No pain was experienced in the cases of fat necrosis. This gave an exact parallel to malignancy, because tumors of the latter type in their early stages exhibit an entire absence of pain. Only in the later, more advanced periods does a cancer of the breast cause pain.

5. *Adhesion to Deeper Structures.*—One of the patients showed definite fixity of the tumor to the underlying muscles. This symptom is almost invariably regarded as a sign of malignancy, and its presence, therefore, strongly influenced the surgeon in reaching a diagnosis of malignancy.

The points of differentiation from malignant disease may be outlined as follows:

1. The history of trauma is more exact and definite than with the average carcinoma.

2. The tumor in fat necrosis is fairly well circumscribed, while the mass in carcinoma is usually more diffuse.

3. The tumor is rather more movable in the breast than is usual with carcinoma.

4. Axillary nodes, if present, have not the hard consistency of those associated with cancer. This differential point would, of course, be of no value in a very early mammary cancer without metastasis in the nodes.

5. The characteristic gross appearances of fat necrosis upon cross-section of the tumor have already been outlined under the paragraph on pathology.

DISCUSSION.—Several points worthy of discussion may briefly be referred to:

In connecting the appearance of a tumor with a history of trauma one should bear in mind the four medicolegal points usually required:

1. The history of trauma must be sufficiently definite and of a severity adequate to produce the tissue damage.

2. The site of the trauma and the location of the lesion must be identical.

3. A proper time relationship must exist from the receipt of the trauma to the appearance of the tissue changes.

4. Proof should be at hand that the tissue was normal before the receipt of the trauma.

All of these requirements, save the fourth, are met in the cases of fat necrosis, and it is obviously impossible to fulfill the fourth requirement.

When the wide distribution of subcutaneous fat is considered, one may well ask the question, Does fat necrosis from traumatism ever occur in the tissue? Our colleague, Doctor Farr, of the New York Hospital,

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has completed a paper, about to be published, in which several cases of traumatic fat necrosis in subcutaneous tissues are reported. Boxers and wrestlers must be subject to a tremendous number of traumatisms to the superficial fat. It seems probable that some defensive mechanism must exist to prevent the development of necrosis in fat tissue following trauma. In the cases in this report it seems fair to assume that some peculiar conditions may have been present, permitting the trauma to bring about the lesions described.

In the first case lues might be thought of as a possible etiologic factor, on account of the miscarriages, the granulomatous appearance of the tissue and the obliteration of endarteritis. However, two Wassermanns in expert hands were negative, and a careful search for spirochætes failed to reveal any organism.

The second patient showed nothing in the tissues quite comparable to the extensive granulomatous changes found in the first patient, and here syphilis could be dismissed at once.

We feel, therefore, that a leucic element in these cases may be positively dismissed as having no bearing upon the pathology of this disease.

### CONCLUSIONS

1. Traumatic fat necrosis of the female breast is a definite clinical entity.
2. It must always be included with the benign lesions of the breast.
3. Clinically, it more closely resembles carcinoma of the breast than any other tumor, and must be differentiated from it.
4. A distinct history of trauma to the breast and a well-circumscribed, firm mass, showing rapid increase in size, unassociated with pain and without axillary nodes that are firm, suggest the possibility of fat necrosis.
5. Local removal of such a mass is justifiable if a proper gross diagnosis can be made in the operating room. Should the gross examination reveal carcinoma, complete amputation may then be performed.
6. The diagnosis of traumatic fat necrosis of the breast by gross examination is possible. The gross features of this lesion should, therefore, be clearly understood by every surgeon.
7. Further lines of research, along chemical as well as along morphological lines, may throw additional light upon the real nature of this process.



## HYPERPLASTIC TUBERCULOSIS OF THE SMALL INTESTINE \*

By JOSEPH RANSOHOFF, M.D., F.R.C.S. (ENG.)

OF CINCINNATI, OHIO

THE protean manifestations of tuberculosis, which elsewhere demand surgical intervention, are not often staged in the alimentary canal. The terminal ulcerations without any trace of reparative effort found in nearly 40 per cent. of cases of fatal pulmonary tuberculosis are practically never surgical.

In the tuberculous peritonitides which call for operation, the causative intestinal lesion has either undergone repair or cannot be found. There remain, then, two conditions which are distinctly surgical. First, the strictures from healed tuberculous ulcers, almost always found in the small intestine either singly or in numbers, and second, the more or less localized processes, which because of their chronicity permit of excessive efforts at repair, and therefore assume the guise of neoplasms. It is to this class of cases that the term "hyperplastic tuberculosis" has been given.

Practically all of the cases reported since Hartman and Pillet<sup>1</sup> first called attention to and named this condition have been found in the cæcum and the terminal coil of the ileum. Just why this segment of the intestine should be the chosen seat for tuberculosis, typhoid, and actinomycotic lesions probably is difficult to answer. Less resistant, perhaps, because of its fixed position, the first stasis in the thereunto fast-moving intestinal current, favoring germ growth, and last, but perhaps not least, the trouble-brewing appendix, may separately and together be invoked in explanation of this striking fact.

Cæcal tuberculosis in contrast with the widely disseminated terminal type in pulmonary cases is nearly always primary, and appears in otherwise fairly healthy individuals of between twenty and forty years. A few cases have been recorded between ten and twenty. Guinon and Pater saw one in a child four years old (Hartman).

Since Hartman<sup>2</sup> was enabled to analyze two hundred and twenty-nine operations for cæcal tuberculosis before the London Medical Society, and very many more cases have been reported since, there would be no justification in adding one or more of this region. Of tuberculosis of hyperplastic type and limited to the small intestine, I have been enabled to find only one other case, that of Soubeyran.<sup>3</sup> The patient was a female, aged twenty-five years. The lesion involved 9 centimetres of the ileum. Resection was followed by death nineteen days after the operation.

The case which I beg to present involves the small intestine only, and that at a part far removed from the cæcum.

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\* Read before the American Surgical Association, May 3, 1920.





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B. S., aged nine years, was admitted to the General Hospital, Pediatric Service, October 13, 1919. The chief complaint was pain in the stomach. Family history negative. Had whooping cough three years ago. Last winter patient had scarlet fever, followed by enlargement of the cervical glands. After continuing for five months the gland was removed, and was shown to be tuberculous. Cardio-respiratory functions normal. X-ray of chest shows no enlargement of the lymph-nodes.

*Digestive System.*—Patient eats fairly well, but does not drink milk. The bowels move three or four times a day, usually with loose stools. For past two or three years patient has been troubled with cramps in the stomach, coming on four or five times a day, and having no relation to bowel movement, but coming on soon after food intake and irrespective of the kind of food. Pain is often very severe, causing him to double up. It usually lasts about an hour, and is finally relieved by the application of hot-water bottle. Pain sometimes comes on suddenly during sleep. It seems to be localized in a small area immediately to the left and slightly below the umbilicus. Patient does not vomit at any time. Renal and vesical functions normal.

*Present Condition.*—Patient is a white male child, apparently about five years of age, but in reality about nine. Expression rather listless, greenish-yellow cast to skin. On the left side of the neck there is an oblique scar, marking the site of previous operation. One small gland palpable in the anterior triangle in the left side of neck.

*Chest.*—Bony framework very prominent, owing to lack of nutrition, development poor. Scapulæ winged, shoulders markedly "rounded," right more so than left, showing tendency to retraction at the apices of lungs. Veins plainly visible. Spine exhibits marked hyposcoliosis, right shoulder droops more than left. Expansion fair, lagging over left apex. Percussion elicits impaired resonance posteriorly to left of spinal column in interscapular space. Auscultation, puerile breath sounds heard throughout chest, no râles heard.

*Abdomen.*—Pot-belly in type, rigidity interferes with palpation, no special tenderness at any point and muscular tension about equal on the two sides. On the left side there is a mass about the size of an apple, can be felt to the left of the midline, below the umbilicus. The mass appears fixed.

*Blood Examination.*—Hæmoglobin, 65 per cent.; red cells, 3,100,000; white cells, 7250; polymorphonuclears, 74 per cent.; large lymphs, 7 per cent.; small lymphs, 15 per cent.; eosinophiles, 4 per cent.

Temperature slightly elevated and irregular, ranging to 100° in the evening. Pulse accelerated most of the time, in the neighborhood of 100. Stool is well formed, devoid of parasites. Test of blood negative. Wassermann negative. Von Pirquet positive.

*X-ray examination* October 21, 1919, of the intestinal tract, following injection of opaque enema and the giving of barium shows the tract to be normal in position and size, and presents no evidence of filling defect. Barium meal passes normally through small intestine.

November 5, 1919, transferred to Surgical Service for exploratory operation. Tentative diagnosis: Retroperitoneal tuberculous glands. Ether anæsthesia. When complete relaxation of the abdominal muscles was achieved, it was found that the tumor mass, irregularly nodulated, was distinctly movable. Through a median incision the mass was easily delivered and was found what appeared to be a discrete growth of the small intestine, situated in the lower part of the jejunum. It involved about seven inches of the gut, and with the exception of a broad omental adhesion at one part, it was not attached. The lymph-nodes in the mesentery were enlarged in lessening degree from the intestinal attachment toward the root. About ten inches of the intestine were resected, together with the mesentery and an end-to-end anastomosis, with sutures, made in the usual way. A thorough exploration of the abdominal cavity failed to reveal any other pathological lesion, nor were any lymph-nodes discernible. The recovery of the patient was uneventful. His condition six months after the operation is satisfactory. He attends school regularly, is free from pain, and presents no evidence of recurrence.

*Pathological Report.*—The specimen removed is a segment of the small intestine, about ten inches in length. It presents the gross appearance of an irregular tumor mass. On section the tumor mass is found to consist entirely of the enormously thickened intestinal wall. This is very rigid and is cut with some difficulty. In thickness this wall varies from 1-3 of a centimetre to 1 centimetre. At the central part there is an attached tag of omentum, 3 centimetres wide. Directly underneath this there is an indurated ulcer. There is a loss of substance in the mucosa, measuring 1 centimetre by  $1\frac{1}{2}$  centimetres. The mesenteric glands on section are of uniform consistency and present no evidence of caseation or other necrotic changes. The rest of the mucosa, to the naked eye, appears unbroken. The surface has a glazed and uniform appearance; the valvular folds normal to this part have quite disappeared. Here and there are minute polypoid elevations.

*Microscopic Report.*—In the sections of the tissue fixed with formalin and stained with hæmatoxylin and erythrosin, the much thickened wall of the gut is seen to be composed entirely of small round-cells and polymorphous epithelioid cells (Fig. 3). Only very rarely a multinucleated giant-cell can be found (Fig. 4). This sarcoma-like tissue extends from the muscular coat to and into the villi of the mucosa, replacing, for the most part, the tissue of the intestine. In only one section are villi able to be seen, and here the submucosa is filled with epithelioid cells, numerous lymphocytes and a few polymorphonuclear leucocytes. The sections show only a slight amount of connective tissue, but many blood-vessels are present. In a few areas there is a transition from cells that resemble spindle-cells (from the outer surface of the wall of the intestine) to uniformly round-cells (in the more central portion of the tumor mass). In other areas the tissue is degenerated, the cells being indistinct, and their nuclei staining very poorly. There is no definite structure or arrangement of the cellular elements, but only a diffuse cellular proliferation.

*Bacteriological Report.*—Attempts were made to stain acid fats and other bacteria with negative results. It must be said that failure may have been due to the method of fixation used.

*Remarks.*—The above case presents several points of interest. The outstanding clinical sign, which should have led us to a correct pre-



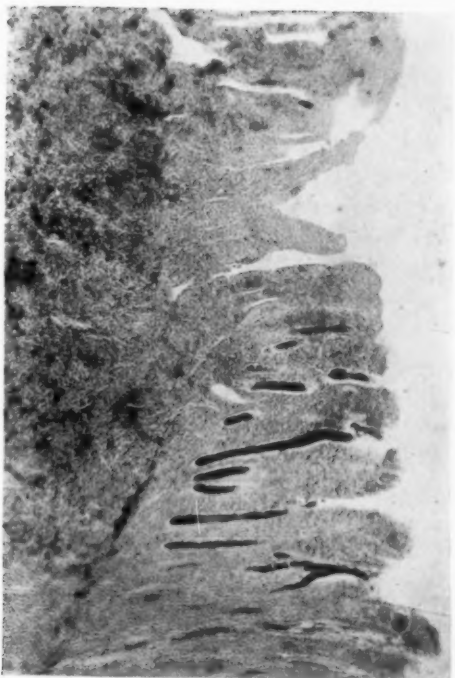


FIG. 3.—Small-cell infiltration of villi.

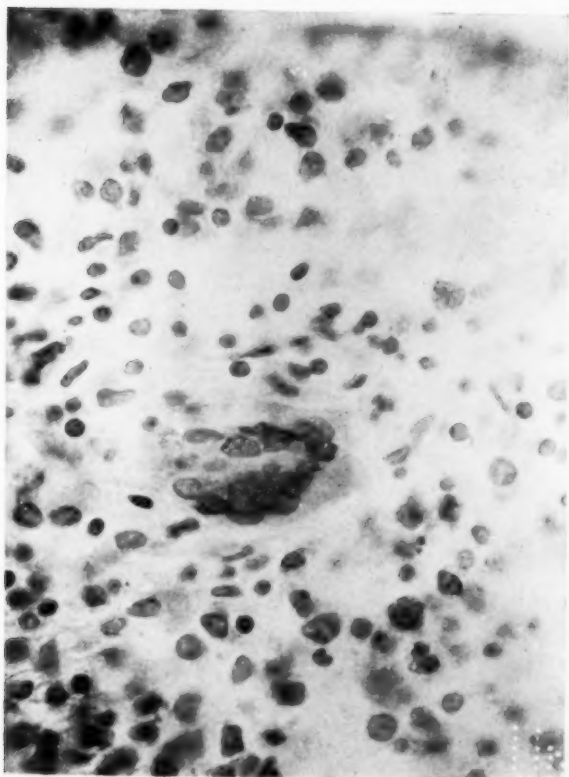


FIG. 4.—Giant-cell infiltration of villi.



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operative diagnosis, was the severity and frequency of the intestinal cramps, which were present for a year or more. The growth appearing fixed until complete abdominal muscular relaxation was obtained, under anaesthesia, and the previous existence of enlarged glands in the neck, led us to believe the mass to be probably of retroperitoneal type. This case well represents, therefore, the clinical value of abdominal examination under anaesthesia. "Prof. Wherry."

In contradistinction to the value of X-ray examinations in diseases of the stomach and of the large intestine, it is found in this instance, as is generally the case, that neither fluoroscopic nor the taking of radiograms is of much service in lesions of the small intestine.

I have termed this a case of hyperplastic tuberculosis. Of its originally being tuberculous in character, there can be no question. A study of microscopic sections, however, makes one feel that in many ways the cells resemble those of an ordinary type of lymphosarcoma. A differentiation from microscopic appearances alone seems impossible, and it is a question in my mind whether it is not possible that we are dealing with the development of a sarcomatous condition in what was primarily purely tuberculous. Of the tuberculosis, one must be certain, because of the clinical history and the ulcer, and perhaps the policeman-like characteristic work of the omentum, as shown in the illustrations. Unfortunately, because of faulty preparation of the specimen when removed, the bacillus could not be demonstrated.

The absence of metastasis at the time of the operation, and the continued well-being of the patient, lead me to hope that the suspicions of malignancy are not well founded. Nevertheless, there have been a few cases reported, particularly of the intestine, in which tuberculosis was associated with sarcoma, and particularly lymphosarcoma.

According to Mikulicz,<sup>4</sup> a combination of tuberculosis and sarcoma, especially of lymphosarcoma, is not unusual. Nothnagel in one case found a lymphosarcoma developed in the base of a healed tuberculous ulcer. A further difficulty is that sarcoma of the small intestine appears in a diffuse form over quite extensive segments of the gut.

The question of the relation of tuberculosis to malignant disease is not a new one. Since the days of Rokitansky, and after him Virchow, there has been a general belief that tuberculosis and malignant growths do not develop in the same soil. As a rule, this is unquestionably true, but by numerous cases it has been shown that they are not incompatible. The most recent publication upon this subject, although it relates more to carcinoma than to sarcoma, in relation to tuberculosis, comes from the Mayo Clinic, in an article by Broders.<sup>5</sup> He reports on twenty cases of tuberculosis and malignant disease occurring in the same organ or tissue eight times, or 40 per cent.; in seven cases, or 35 per cent., the two conditions were actually associated in the same microscopic field.

JOSEPH RANSOHOFF

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## ACUTE INTESTINAL OBSTRUCTION. THE CAUSE OF THE CONTINUED HIGH MORTALITY; HOW THIS MAY BE REDUCED \*

BY JOHN E. SUMMERS, M.D.  
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ALMOST the last written words of the late Dr. John B. Murphy were upon subjects included in the title of this paper, and I want to make a short quotation from what he wrote: "From most reliable statistics we find 40 per cent. mortality in acute intestinal obstruction. One may well ask will this appalling mortality ever cease? Why does it exist? Because the diagnosis is not made in time for a life-saving operation. The technic in this line of operation is superlatively good, but the clinical recognition is extremely tardy." Personally, I believe that both the operative technic in certain instances, and the post-operative treatment can be greatly improved, thus contributing towards lessening the mortality.

In a paper published in the *ANNALS OF SURGERY*, February, 1915, entitled "The Mortality Statistics of Two Hundred and Seventy-six Cases of Acute Intestinal Obstruction," Doctor Deaver shows that of these 276 cases there were 118 deaths—a mortality of 42 per cent. All of these patients were admitted into the German Hospital under his care, during a period of ten years. There were 156 cases of strangulated hernia and 120 of the different types of internal strangulation. In 241 cases there were adequate records of the average time from the onset of the condition to the time of operation. In the cases that recovered it was sixty-one and seven-tenth hours, or over two and one-half days, and in the cases that died ninety-seven hours, or four days and one hour. Doctor Deaver remarks, "Under such conditions it is to be wondered at that so many cases had a fortunate outcome." In a letter of recent date, Doctor Deaver writes me and says: "In my hospital and private practice I have not noticed any decrease in the mortality of acute intestinal obstruction since 1915; nor have I noticed any difference in acute appendicitis; both conditions are either not recognized early or have been badly treated by purgation, as you and I both know. The younger men who have graduated in the last two or three years I am sure will be the ones to reduce this mortality. I quite agree with you, much has to be gone over before the essential is grasped."

Sir Berkley Moynihan says that "To operate early in a case of intestinal obstruction is an experience that few surgeons often enjoy." He says that, "There are few surgeons who can show a mortality lower than 50 per cent."

In every country where medical education is acknowledgedly in keep-

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ing with the age, the same story is told—patients with intestinal obstruction come to operation too late—hence the chief reason for the high mortality. One report from St. Bartholomew's Hospital, London, gives a recovery of only 15 cases out of a total of 60. In France and Italy the same kind of reports are to be found.

Before this audience it would be a supererogation upon my part to attempt to add anything in the differentiation of acute intestinal obstruction from other pathology as generally recognized, but I would strongly recommend the teachings of the late Dr. J. B. Murphy as published in his Clinics, as the best expositions of the diagnosis of acute intestinal obstruction. I would also like to recommend particularly the writings of our fellow member, Dr. John B. Deaver.

When the diagnosis is made within the first twenty-four hours, the operation done promptly, the obstruction relieved and the gut viable, the patient usually recovers. The small mortality results from the same causes as when the operation is done later, only there is added in the latter the condition of enormously distended intestines filled with poisonous gases and fluids. In no circumstances should the bowel ever be left in this condition. It should be largely evacuated through one or several small incisions which are later closed with perhaps a drain in one, fastened in with purse-string sutures. I do not like the employment of an enterotomy tube, as recommended by Moynihan, for the immediate drainage of the distended bowel. If the same patient has been copiously vomiting foul, fecal-smelling fluids, my judgment is that through a high left rectus incision a 20-22 (French) catheter should be introduced into the jejunum as near the origin as recognizable, and fastened in as indicated above. Nature points out the route; the drainage direction has become retrograde; the intestinal current is reversed—its drainage will remove the source of the fatal auto-intoxication which is killing the patient; the absorption, too, from the upper small intestine, considered so fatal, is greatly reduced. *The vomiting ceases.* This is a positive proof of the efficacy of the procedure. It is remarkable the large amount of foul fluid that will drain out of a catheter so placed; very much more and in a much shorter time than will take place through a drain introduced in the lower part of the distended gut. When we consider that Nature is trying her best to rid the bowel of its poisonous contents and relieve the pressure against the obstruction by reversing the current and expelling the fluids and gases by vomiting, not to assist her by opening the jejunum would appear unfair. I am convinced, also, that in advanced cases the introduction of a catheter drain into the jejunum will not infrequently save life, provided no attempt is made to open the abdomen for exploration or other surgical effort. The cause of the obstruction can be taken care of later. Of course, there is always the risk of a fatality from peritonitis secondary to gangrene. Post-operative peritonitis with paralytic obstruction and foul vomiting should be given the hopeful help of a

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jejunostomy. It can be used as a prophylactic measure when post-operative peritonitis may be anticipated. My attention was first called to this jejunostomy procedure by a paper of Victor Bonney's in the *British Medical Journal*, April 22, 1916, entitled "Fecal and Intestinal Vomiting and Jejunostomy." He had advocated and practiced the procedure and published it in the Middlesex Hospital Reports in 1910. He reported six successful cases. Bonney's technic was the establishment of drainage through a jejunal fistula, which later required a second operation to close.

McKinnon, of Lincoln, Nebr., who has saved a number of lives by the technic I have outlined, says that the catheter comes away after two or three days, and that the opening in the jejunum closes shortly afterwards. My experience is the same. We know that the opening closes likewise when the catheter is properly placed in the bowel lower down. Bonney divides the obstructed intestine into three segments: the lower, middle, and upper; the lower more or less collapsed, the middle containing gas, the upper containing fluid. My experience is that the lower and middle segments contain gas chiefly; the upper segment most of the fluids.

"The character of the vomited matter indicates the condition of the upper part of the intestinal tract, for where the vomiting is fecal or intestinal the stomach forms the highest part of the fluid-containing segment. This upper segment does not necessarily reach as high in every case of intestinal obstruction when it first comes under clinical observation, nor need it at first include any part of the small intestine; for if the primary obstruction is situated low down in the large intestine, the total area of distention may not at first extend above the ileocaecal valve. In such the 'segment of toxicity' will comprise the caecum and descending colon. In this phase the vomit is neither fecal nor intestinal, but simply the stomach contents. In all cases of obstruction, however, the stomach and jejunum will eventually be included in the fluid-containing segment, and so soon as this occurs the fact is made patent by the change in the character of the vomit, which at first becomes intestinal and finally fecal.

"This upward extension of the limits of the fluid-containing segment is due to a rapid upwardly extending infection of the canal by organisms of the lower intestine."

As Bonney says, "The drainage opening must tap the fluid-containing segment."

When the obstruction is in the sigmoid a drain should be put into the caecum. My time is too limited to more than suggest the intra-abdominal technic indicated by conditions presented. When the mechanical cause of the obstruction has produced gangrene of the annular or napkin-ring area type, resection should not be done, but the gangrenous area should be invaginated as an intussusceptum and the gut properly sutured so as to form an intussusception. The gangrenous part sloughs off and the integrity and continuity of the canal is restored. I introduced this tech-

nic, reporting cases, in a paper published in the *Journal of the American Medical Association*, 1907. It is a reliable procedure and its principles can be broadened. I have recently shown in the December, 1919, number of the *Nebraska State Medical Journal* how the principle can be applied when resection is deemed advisable. Girdin, of Rio de Janeiro, adopted my suggested method of resection without opening the gut, and Pauchet recently reported in the *Bulletins et Mémoires de la Société de Chirurgie de Paris* three cases of megalocolon resected after this manner. The making of an anastomosis, thus side-tracking an obstruction, is a wise thing to do if the releasing of the obstruction threatens to injure the bowel so that a resection might be necessary. The saving of time is one of the most important elements in the carrying out of a successful operation.

I am a great believer in the scientific principles upon which Crile bases his operative and post-operative treatment in general surgery, and more particularly so in its application in grave cases of abdominal surgery. The profession, except, perhaps, in goitre surgery, has not grasped the importance of Crile's work.

Crile says that, "By employing water, hot-packs, and morphine in post-operative treatment—this latter to reduce the respiration 10-14 per minute—the surgeon can play the patient almost at will. The control of the drive, as marked by the changes in the respiratory rate in particular, is dramatic. Morphine lowers the respiratory rate, decreases the peristalsis of the intestines, reduces pain, and secures physiological rest and sleep, the prime means of recuperation."

This same kind of post-operative management is the one I have been using for some time and gives me great confidence in handling dangerous cases. As far as the employment of morphine is concerned, it has always been my practice to employ it as Crile indicates. Alonzo Clark was my teacher and I have always followed his teachings in the treatment of peritonitis. I have never been guilty of giving salines in the treatment of peritonitis, which was for some years in vogue as the result of the recommendations of several surgeons and physicians then in high authority. I am convinced that by early operation and the doing of only the essential, doing it rapidly and well, the establishment of proper drainage, and the employment of the "anociated" treatment, the mortality of acute intestinal obstruction can be reduced 25 per cent., perhaps 50 per cent. In reply to a recent personal note to Doctor Crile, he writes me: "In our clinic the high mortality attending the critical situation presented by acute intestinal obstruction did not begin to fall until we became cognizant of the damage resulting from auto-intoxication *per se*. With the recognition that this danger by so much lessened the patient's chance for recovery, we employed the shortest possible operation, avoided lipid solvent anæsthetics, employed hot packs, and the Alonzo Clark opium treatment after the operation, with sodium bicarbonate and glucose *per rectum*. A study of over 219 operations for intestinal obstruction shows a

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falling mortality rate beginning with the adoption of the methods outlined above."

Among a number of cases of intestinal obstruction seen during the past year I want to briefly report, as illustrative of types, six operated cases.

CASE I.—Acute obstruction in a case of carcinoma of the sigmoid. A large, heavy man, aged fifty-four years. Late operation (Clarkson Hospital) third day of obstruction; exploration disclosed a carcinoma of the sigmoid adherent to the abdomino-pelvic wall; small bowel and colon much distended and dark in color. Cæcostomy; three weeks later resection of the sigmoid; deep cauterization with soldering irons of the area where the carcinoma was adherent to and infiltrating the abdomino-pelvic wall. Later closure of the cæcostomy. Man now in perfect health. Operation done one year ago.

CASE II.—Woman, aged fifty-five years, in poor general health; acute obstruction from carcinoma of splenic flexure of the colon. Exploratory incision (Clarkson Hospital); colon much distended; cæcostomy; two weeks later resection of the colon; death in a few days from exhaustion.

CASE III.—Woman, aged forty years, marked abdominal distention; foul vomiting. Late operation (University Hospital). Median incision—small bowel very dark and enormously distended. Nearly two basinfuls of contents evacuated through three small incisions; openings sutured; anastomosis by suture around a loop of small gut adherent to the left abdominal wall—so tightly adherent as to cause obstruction, and in a condition so threatening perforation that I feared to attempt its release. Patient left the table in a collapsed condition, but recovered.

CASE IV.—Young man entered the Clarkson Hospital; he was very sick, having been ill for ten days with appendicitis; there was a large abscess bulging in the lower middle abdomen; incision and drainage of the abscess was done; a fecal fistula developed, evidently in the lower ileum. The bowels moved naturally and through the fistula; later only through the fistula. Operation—anastomosis by suture around the fistula; death some days later from exhaustion. Post-mortem disclosed the anastomosis perfect, fistula in ileum only a few inches from the ileocaecal valve.

CASE V.—Woman, aged thirty-eight years, operated in a neighboring city (Fremont). Acute obstruction for forty-eight hours; foul vomiting; considerable distention. Incision disclosed that the obstruction was due to a band, probably from a pelvic operation done four years previously; the band was divided. Although the intestines were distended and dark, I did not drain them, and I believe I took an unwarranted chance in not doing so. The woman recovered.

CASE VI.—A man sixty-five years of age came to the Clarkson Hospital with an appendiceal abscess which was opened and drained. Before the wound closed he developed an acute intestinal obstruction. A jejunostomy as described was done at night, under local anaesthesia, the patient being in bed. Relief was prompt; the obstruction was overcome and the jejunostomy incision closed satisfactorily.

## JOHN E. SUMMERS

### CONCLUSIONS

1. Teachers of medicine and surgery should impress by personal acts the philosophy of early diagnosis and prompt surgical treatment.
2. A safe two- or three-stage operation is preferable to any radical procedure which would add much risk as a completed operation.
3. When vomiting has reached the stage of being foul, fecal smelling, always drain the small bowel as high up in the jejunum as it is recognizable. Nature points out this route.
4. Anæsthesia should be local—plus gas oxygen if necessary.
5. Post-operative. Opium should be administered after the Alonzo Clark formula. Large quantities of normal salt solution should be given by hypodermoclysis. Sodium bicarbonate and glucose in 5 per cent. solutions should be administered by the Murphy drip method. Under this treatment the skin will be active if kept warm, and reaction from shock and toxæmia favored.



## CAUSES OF DEATH BY ACUTE APPENDICITIS AFTER OPERATION \*

STUDY OF TWO HUNDRED AND FIFTY-FIVE Cases

BY ARCHIBALD MACLAREN, M.D.  
OF ST. PAUL, MINN.

THE best pathologists tell us that there are five varieties of peritonitic inflammation caused by pyogenic germs, and that it is not always possible to distinguish between them and that all five types may exist in the same case at the same time.

A. B. Johnson's surgical diagnosis gives the following varieties: (1) Localized abscess. (2) Diffuse spreading acute peritonitis with fibrino purulent exudate. (3) Acute peritonitis with cloudy serous exudate. (4) Fibrinous type, alone, fibrin existing in thick masses. (5) Accumulations of slightly cloudy sterile serum.

Johnson says that one of the most frequent causes of peritonitis is the rupture of a gangrenous appendix. Some of the worst cases of peritonitis that we have had to deal with were caused by the rupture of an appendix which was not gangrenous but which contained from one-half drachm to one teaspoonful of pus. Such appendices may lie dormant for months following a preceding acute attack, but ulceration eventually occurs with the sudden discharge of the contained pus directly into the free peritoneal cavity. The first pain, under such circumstances, meaning the commencement of a septic peritonitis.

When we include in the study of acute appendicitis cases which do not show pus at operation, we are deceiving ourselves, and confusing the subject by including cases in which there is almost no mortality, with cases that are extremely dangerous. In our clinical experience it has often been impossible to determine whether in certain border-line cases we were dealing with appendiceal abscess or some other form of appendiceal peritonitis.

In this list we have eliminated all cases of relapsing appendicitis, even when operated upon, during an acute attack. We have limited this study to septic peritonitis due to perforated appendices, and to appendiceal abscesses, including no case in which pus was not present.

We have not been able to lay down any definite rule which we should always follow in treating the individual appendiceal case. Each one must be decided on its own merits. We have occasionally postponed operation when we felt sure that the attack was subsiding. But if the case was growing worse (and from a short study), was progressing toward a fatal termination, we have not hesitated to operate at any time during

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\* Read before the American Surgical Association, May 3, 1920.

the attack. In this list of 255 cases no case has been denied operation. Every one has been given a surgical chance. In studying the thirteen cases in this series which have died, we will not be sure but that two of these patients might have had a better chance of escape if they had been delayed according to Ochsner. But, on the other hand, we cannot forget some four cases which died in the hospital under our care years ago, when we were trying out "the waiting for the eighth day policy."

*Incision.*—When it has been decided that an operation should be performed for acute appendicitis we advise making a simple straight incision over the appendix just to the outside of the right rectus muscle. Do not use a cross muscle incision for this class of cases. We have had two deaths due to the cellulitic, or gas bacillus, infection with excessive sloughing of the loosened-up muscular and fascial planes in the McBurney incision. In one case reported later in this paper the cellulitis ran around into the tissues of the back, and the patient died on the eighteenth day with a clean peritoneal cavity. We would also advise against sewing these wounds up tightly. We feel sure that we have saved some of these worst septic peritonitis cases by not putting in any stitches at all, simply relying upon adhesive strapping to keep the intestines in the peritoneal cavity. The strapping does not interfere with drainage, and the ultimate wound results are amazingly good. In treating these cases we should remember that we are trying to save the patient's life, not to avoid hernia. The operative hernia can be repaired at some future date. The patient has only one chance of escape.

In treating these bad septic peritonitis cases we should remember that animal experimentation has tended to prove that peritonitis in itself is not necessarily fatal, only when the animal has a raw surface under his liver, following cholecystectomy in the presence of septic peritonitis, was the case sure to die, and usually in the first twenty-four hours (experiments P. P. McNeen, Ricketts Laboratory), which proves what we have known clinically for many years, "that the peritoneum protects the system against bacteræmia." A great measure of success in the treatment of septic peritonitis cases depends upon the wise handling of the complications of the disease. After thorough drainage the peritonitis usually quickly subsides. But occasionally an undrained accumulation of pus will form in either kidney pouch, above or below the liver, but usually in the pelvis. When we have recognized these accumulations early and drained them, the case usually has recovered. When we have not found them early enough, the case has died even after drainage. We have always found at post-mortem an unrecognized abscess which, if we had discovered early enough and drained, the case perhaps might have recovered. Intraperitoneal drainage uphill will work well for from twenty-four to possibly forty-eight hours, but after that time the intestinal coils become so firmly adherent to each other around the drain that all intraperitoneal pressure is destroyed and we are then try-

## POSTOPERATIVE APPENDICITIS DEATHS

ing to drain an iron pot through a drain put in at the top. We have frequently seen an old ten to fifteen day appendiceal abscess case discharging profusely through an upper drainage opening, while the pelvis was filled with a large abscess bulging against the anterior rectal wall (Figs. 1 and 2).

More than one-half of our deaths have been late deaths, the patient dying, not from acute peritonitis, but rather from exhaustion due to prolonged intraperitoneal suppuration. A few die from intestinal obstruction due to bands, but more frequently these obstruction cases are septic ileus. Our cases have died chronologically after operation: One on the eighth day; one on the tenth day; one on the twelfth day; one on the eighteenth day; two on the twenty-first day; one on the thirty-third day.

As regards time of operation after perforation we have operated during the first forty-eight hours 69 times with 5 deaths, or, a mortality of 7.1 per cent. Third day, 29 times; fourth day, 11 times; fifth day, 14 times; sixth day, 8 times; seventh day, 7 times; total, 69 operations during the dangerous period of Ochsner with the same mortality, 7.1 per cent. One case that died of opium poisoning the same night which she was operated upon, has been excluded from this classification. Of the remaining 117 cases all have been operated upon on and after the eighth day with two deaths, or a mortality of less than 2 per cent.

We have at times drained a well-marked accumulation of pus in the pelvis either through the vagina or through the rectum as a preliminary, or first step, and then immediately after have opened the abdomen and dealt with the intraperitoneal pathology according to ordinary surgical rules. Our experience has been that quantity, as well as quality of pus, is an important factor in the danger attending this operation, so, if by pelvic drainage we can reduce the quantity of pus in a certain case, we have by that amount lessened the danger of the succeeding laparotomy.

After pelvic drainage we have usually found that there was, at least, one other abscess aside from the accumulation in the cul-de-sac, and this was, as a rule, next to the perforated appendix. This is the reason why it is not wise to rely upon pelvic drainage alone. If the patient, often a child and in bad physical condition, is seen several days after perforation, it may be wise to drain through the rectum one day and postpone the opening of the abdomen until the next day, but not much longer (see Case XII).

The secret of success in these cases is eternal vigilance. Watch them with great care; make frequent rectal examinations; palpate the left side of the abdomen, and be prepared to explore under local anæsthesia. If there is a return of pain and rigidity, or a marked rise in temperature and pulse, early opening and drainage of secondary abscesses will save the patient, later opening of this same abscess will not always help. We have had two deaths within the first twenty-four hours; after finding and draining the large, late abscesses (Cases III and XI) in the 255 cases which we are here reporting, there have been thirteen deaths, or a general mortality

of 5.09 per cent. In securing these results vaginal drainage of pelvic abscess was used ten times; rectal drainage was used 33 times; occasionally before operation, but usually some days after laparotomy. In complicating intestinal obstruction the formation of fecal fistula, and drainage of the intestine with a Paul's tube has been at times a great help. This has been done ten times.

In this paper we are reporting in detail the thirteen deaths which have occurred in 255 acute appendicitis cases, hoping they may be of interest and furnish some instruction. These 255 cases are all consecutive cases operated upon personally at the St. Paul, Minneapolis, and Stillwater hospitals. A few other cases operated upon in the country where it was not possible to keep close watch and make frequent examinations have not been included.

This list extends back some eight years, and during that time we have materially changed our views regarding treatment, so that we now feel that some of the cases which have died have been properly treated, and the deaths could not, in our present judgment, have been avoided. Others were not given as good a chance as they would have to-day, and we think that some of them should have been saved.

CASE I.—*Morphine poisoning*. No. 2994. Child, aged six years, sick five days, evening of fifth day became distended. Temperature  $103^{\circ}$ , acute gangrenous perforated appendix; accumulation of serum in the cul-de-sac. Abscess opened and drained. That night very restless, nurse had difficulty in keeping her in bed. At 10 P.M. nurse gave hypodermic of morphine  $1/12$  gr.; two hours later (because of no relief) second hypodermic  $1/12$  gr. morphine. Died 3 A.M., morphine poisoning, pin-point pupils, and respiration of six or less.

#### OPERATIONS PERFORMED IN FIRST FORTY-EIGHT HOURS

CASE II.—No. 3465. In this case perforation occurred forty hours before seen. Diagnosis: General septic peritonitis, gangrenous perforated appendix. Appendix removed: Drain through stab, just outside cross muscle incision. On the eighth day was very sick from extensive carbuncle-like infection of skin of side and back. Died on the eighteenth day. General septicæmia with enlargement of all glands everywhere. Abdomen, no accumulation of pus.

CASE III.—No. 3717. Young man, aged twenty-seven years. First attack commenced thirty-six hours before seen. Took long auto ride day previous. Vomiting at night. Temperature,  $100^{\circ}$ ; pulse, 85; abdomen rigid; operation St. Luke's Hospital, septic peritonitis; acute gangrenous perforated appendicitis. Three ounces of thick pus with dense adhesions about appendix. One pint of thin serous pus in cul-de-sac, split rubber tube into pelvis through stab opening. Two days later tube out and catheter drain put in. Quite well until ninth day; pelvic distress. Temperature  $101^{\circ}$  and vomiting. On the twelfth day rectal section. Three pints of serous pus let out and



FIG. 1.—Abscess behind bladder pressing against the anterior wall of the rectum.

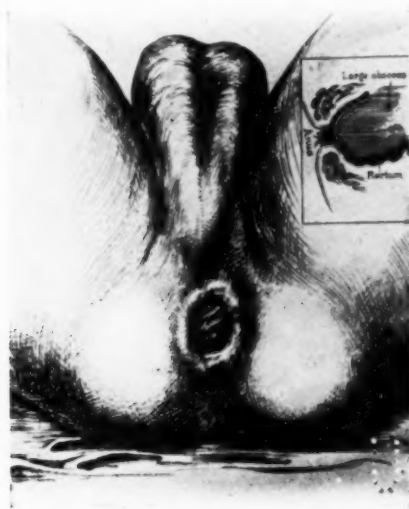


FIG. 2.—Abscess anterior to rectum bulging through the dilated anus.



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## POSTOPERATIVE APPENDICITIS DEATHS

tube put in. Patient died same night. Post-mortem: No pus in pelvis, but large amount of pus in upper abdomen.

CASE IV.—No. 4368. W. C., care of Doctor Humphrey, of Stillwater, several attacks before, last attack three months ago. This attack commenced eighteen hours before seen; operated in Stillwater Hospital. Acute gangrenous perforated appendix. Pint of thin serous pus all through lower right abdomen, not much pus in the cul-de-sac. Drain through the suprapubic stab. A second drain into the right loin. Died on the fourth day. Septic peritonitis. Post-mortem: Mesenteric thrombosis. Several intestinal perforations. One in transverse colon, two or three in lower ileum.

CASE V.—No. 4671. Man aged forty-three years. Two previous attacks. This attack commenced five and one-half hours before operation, rapidly growing worse. Septic peritonitis. Gangrenous perforated appendix. Pocket of sero-pus about appendix, also a large accumulation in cul-de-sac. Wound left opened strapped. Died twenty-four hours after operation.

CASE VI.—No. 4759. N. W. T., care of Doctor Humphrey, of Stillwater. Operation, Stillwater Hospital. One previous attack eight months ago. This attack commenced forty hours before seen with very severe pain, running into the pelvis and right testicle, and general rigidity. Gangrenous perforated appendix, enterolith in perforation. Eight ounces of sero-pus, with marked intestinal distention. Appendectomy: Two cigarette drains, one into pelvis and one into right loin. On the fourth day sudden vomiting of a very large quantity of black liquid. The man strangled during vomiting and died at once, drowned in his own vomit. Post-mortem: No peritonitis, but acute dilatation of stomach.

### OPERATIONS PERFORMED AFTER FIRST FORTY-EIGHT HOURS

CASE VII.—No. 3057. Care Dr. Kerr Martel, aged forty years. Perforation five days before seen. Temperature, 102°; pulse, 100. Not doing well, abscess opened and drained through cross muscle. (Free peritoneal cavity not opened.) One pint of thin serous pus. Died of general septic peritonitis twenty-four hours later on the sixth day. Post-mortem: General peritonitis and perforated gangrenous appendix.

CASE VIII.—No. 4255. M. L., care of Doctor Perrin, Star Prairie, aged thirty-five years. Perforation six days before seen. Temperature, 103°; pulse, 120. Had colicky pains several days before perforation. Acute septic peritonitis. Large accumulation of fluid in right abdomen up into right kidney pouch and large accumulation in cul-de-sac. Appendix gangrenous and perforated, leaking pus; small incision outside of right rectus. Appendix removed and pus sponged out. Pelvis drained. Tapped with tube. Pus spurting two inches above abdominal wall, when the tube was put into the cul-de-sac. Felt much better that night. Died the second night after operation. Post-mortem: Septic peritonitis.

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CASE IX.—No. 4804. C. A., care of Doctor Epley, of New Richmond. Man aged forty-five years. Several attacks before. This attack commenced five days ago. Acute perforation four hours before, evidently due to rupture of abdominal abscess. Septic peritonitis, perforated, gangrenous appendix. Appendix removed: Two drains, one tube in right loin, one into cul-de-sac through wound. On the seventh day on account of intestinal obstruction rectal section. On the ninth day intestine drained with Paul's tube. Died of exhaustion on the twentieth day. Post-mortem: Large abscess; two pints of serous pus in left side of abdomen.

CASE X.—No. 5028. R. B., care of Doctor Paxton, of St. Paul. Young man, aged twenty-one years. First attack commenced four days before seen. Not very sick until 2 A.M. on fifth day, when gave first symptoms of perforation. Immediate operation. Acute septic peritonitis. Small intestine coils red and distended. Ruptured appendiceal abscess with gangrenous perforated appendix. One pint of serous pus. Appendix removed. Cæcostomy and drainage of intestine with Paul's tube. Died on the eighth day of septic peritonitis.

CASE XI.—No. 4376. A. S., boy, aged twelve years. First attack commenced four days before seen. Gangrenous perforated appendix, abscess outside of cæcum. Gangrenous spot on cæcum size of quarter of dollar. Appendix removed. Stab drain into pelvis, second drain into right loin through wound and tube drains. On the fifth day fecal fistula discharged through wound. On the twentieth day another abscess opened. Died on the twenty-first day of exhaustion.

OPERATIONS ON OR AFTER EIGHTH DAY

CASE XII.—No. 3116. Little girl, aged seven years, sick five days. Temperature, 104°; pulse, 130. Diagnosis: Acute gangrenous perforated appendix, large pelvic abscess. Rectal section: Pint of pus. Should have had laparotomy on the second day. Eight days after rise of temperature and pulse with vomiting. Laparotomy abscess in the right loin, gas and much pus. Two days later (or tenth day) died of exhaustion.

CASE XIII.—Last case seen with Doctor DuBoise, Sauk Center. Brought to St. Paul on a cot in baggage car. General abdominal rigidity. Temperature 102°; pulse, 125; some vomiting. Deep pelvic abscess present in rectum. Rectal section on fourth day. One pint of sero-pus let out. On the eighth day laparotomy. Gangrenous perforated appendix removed and small right loin abscess opened and drained, wound left open strapped. On nineteenth day sub-diaphragmatic abscess ruptured with return of rigidity and temperature, 103°; pulse, 140. Very sick. Abdomen opened under local anæsthesia. Large left seropurulent accumulation opened and drained. Cæcum opened and tube put in. Died on the thirty-third day of exhaustion.

## POSTOPERATIVE APPENDICITIS DEATHS

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- Billington: 360, 48 deaths, 13.3 per cent.
- Burgess: 365, mortality 10.6 per cent.
- Paterson: 56, mortality 8.9 per cent.
- Richardson: 350, mortality 13.7 per cent.
- Irwin: 84 cases, mortality 11.9 per cent.
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## OPERATION FOR CURE OF LARGE VENTRAL HERNIA \*

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A BRIEF description of this operation was made in my article on "Post-operative Intestinal Obstruction," *ANNALS OF SURGERY*, April, 1916. My experience in this particular procedure now numbers eight cases and the results have been very gratifying. This operation is not intended to supplant the customary operations for repair of incisional hernia or cure of umbilical hernia. It is intended for those cases for which the ordinary operations are not applicable and, in fact, usually quite impossible. The bulk of these cases would have been denied operative relief or subjected to some procedure of doubtful value, such as the implantation of a filigree.

The first operation in 1914 was done on the spur of the moment in an effort to give the patient a competent abdominal wall which was necessary to her profession as physical training instructor. It was felt at that time that the particular procedure used was somewhat hazardous, and it was a source of surprise and gratification that the operation succeeded perfectly, and at the end of six years there are no signs of any recurrence and the functional result is perfect.

Encouraged by this original result, similar operations were performed in cases of increasing magnitude, some of them apparently too great to be overcome. Success, however, attended all cases except the last (Case VIII), which showed that the limit of operative possibilities had been attained. This was a recurrent case (see photograph) with enormous prolapse and a conservative estimate was made at the time of the operation that the abdominal gap would easily correspond to the size of an adult head.

*Operation.*—The main principle of the operation is to close the gap chiefly by approximating the refreshed edges of the sheath of the rectus, tension being relieved by releasing incisions parallel to the line of suture on either side. This procedure is exactly similar to the operation for closure of cleft palate, according to Langenbeck, by double pedunculated flaps.

The operation is long and tedious. Before the abdominal incision can be closed the herniated contents of the sac must be properly separated and reduced. The closure is made in layers: first, peritoneum, which usually does not present any great difficulty. The next layer is usually quite deficient, as the muscles have disappeared, either from the original suppuration and sloughing or from atrophy. However, as much tissue as can be sutured under the fascial layer is secured. The releasing incisions

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\* Read before the American Surgical Association, May 4, 1920.



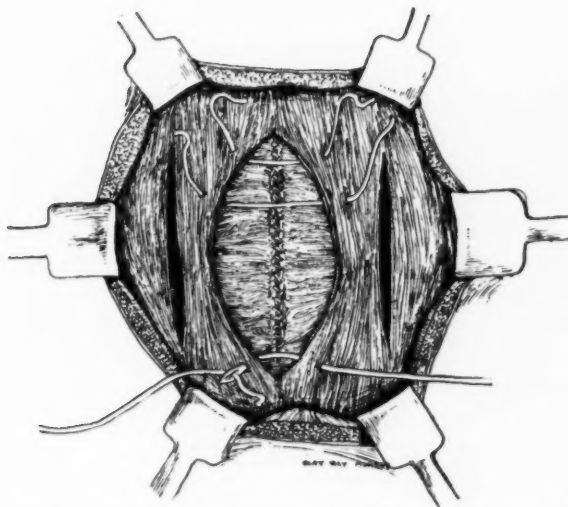


FIG. 1.—Releasing incisions in the fascia of the rectus muscle parallel to the line of suture.

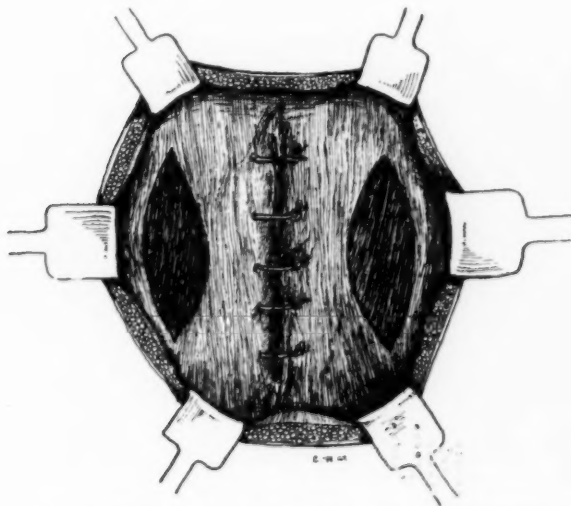


FIG. 2.—Edges of fascia reunited in midline without tension.



## CURE OF LARGE VENTRAL HERNIA

can be made before or after the suturing of the refreshed fascial edges. In extreme cases it must be made before. The width and length of the fascial flap can be determined by the conditions of tension. One must have the courage of one's conviction and extend the releasing incisions sufficiently to take off all undue tension. Ordinarily the flap of fascia would be about two inches wide. The greatest difficulty in making these flaps is in cases of hernia through the upper mid-abdomen, where the releasing incisions have to be carried on to the costal arch. Chromic catgut, mostly interrupted sutures have been used for the fascial closure. These sutures may be sometimes reinforced to advantage by passing some silk-worm gut sutures through all the layers superior to the peritoneum.

Experience has shown that most of these wounds do not heal by primary union and a certain amount of discharge, usually non-purulent, is to be expected. It is possible that this accident is caused by spots of necrosis due to too great tension on the fascial sutures. Therefore, the superficial wound should be appropriately drained. Notwithstanding this complication in wound healing, none of these cases seem to have been injured as far as regards curative results.

My experience comprises eight cases. The ninth case, done according to the technic described here by one of my colleagues in my service, did not survive, succumbing to operative shock and paralytic ileus. Of the remaining eight cases only Case VIII, the severest, has shown any signs of recurrence. Case V is particularly interesting, as the patient had been subjected to numerous operations for an abdominal hernia which developed sixteen years prior to my intervention and had worn a filigree for five years which had successfully overcome the hernial protrusion for four years.

The surprising feature in the after results of these cases is the lack of weakness of the abdominal wall where the fascia gapes as the result of being pulled away. I had feared originally that there would be more trouble of possible protrusion at this point than of recurrence of the hernia, but with the exception of the case noted no trouble has developed.

CASE I.—I. F., aged thirty-four years, female.

*First Operation.*—February, 1912. Operation for appendicitis.

*Second Operation.*—April 14, 1913. Resection of 20 inches of ileum and anastomosis with Murphy button for intestinal obstruction. At discharge, June 14, 1913, wound was closed save for small spot at lower angle.

*Third Operation.*—February 24, 1914. Hernia appeared three months previously (November, 1913). Operation for ventral hernia complicated by chronic adhesive peritonitis. Several feet of intestines unravelled. Wound healed by primary union save where hæmatoma had formed, broken down, and discharged. Discharged March 20, 1914.

*Follow-up Notes.*—June 10, 1914: Abdominal wound firm. No

suspicion of bulging in the wound or elsewhere in the abdomen. February 1, 1920: Excellent condition.

CASE II.—N. W., aged thirty-nine years, male.

*First Operation.*—Cholecystostomy for cholelithiasis. February 13, 1915. Complicating operation, patient had an acute bronchitis and in coughing stitches yielded. Large hernia formed in scar.

*Second Operation.*—October 9, 1915: On ninth post-operative day wound was found infected. On tenth post-operative day free discharge of bile, probably all coming out of sinus in midline. Union of fascia and muscle for the most part seems firm, bulk of wound having escaped infection. On twenty-third post-operative day still profuse biliary discharge. Hernia operation seems to have held; condition excellent. On thirtieth post-operative day discharge markedly decreased. Abdominal repair seems to be firm. On thirty-ninth post-operative day patient discharged (November 17, 1915). Wound healed by primary union save at upper angle where wound opened to allow escape of biliary discharge, now slight in amount.

*Follow-up Notes.*—January 3, 1916: Discharge has returned. No impairment of abdominal wall. May 16, 1917: Wound firmly healed. Excellent condition. May 31, 1919: Excellent condition. No recurrence.

CASE III.—L. P., aged nineteen years, male.

*First Operation.*—June 12, 1913: Appendectomy and drainage for acute appendicitis. Hernia developed two weeks after discharge. Has gradually increased in size until protrusion is now the size of two fists.

*Second Operation.*—April 3, 1916: Convalescence delayed by superficial hæmatoma. Discharged thirty-eighth post-operative day. Skin edges still separated. No impulse on coughing.

*Follow-up Notes.*—October 26, 1916: Wound firmly healed. No impulse. January 10, 1917: Excellent condition. Gaining flesh. Scar firm. February 27, 1919: Excellent condition.

CASE IV.—J. F., aged sixty years, male. Hernia not post-operative. Has had ventral hernia for over four years. Came out gradually. Is now about size of fist. Strong impulse on coughing.

*Operation.*—July 26, 1918: Discharged August 13, 1918. Wound healed primarily.

*Follow-up Notes.*—March 6, 1920: No recurrence.

CASE V.—C. S., aged fifty-one years, female.

*First Operation.*—October 16, 1902: For epigastric hernia.

*Second Operation.*—August 15, 1912: Repair of ventral hernia.

*Third Operation.*—September 8, 1913: Repair of ventral hernia with insertion of wire filigree (local anæsthesia).

*Fourth Operation.*—Readmitted October 29, 1918. One year ago patient noticed bulging to left of old ventral hernia repair scar. Wire broke through skin about  $\frac{1}{2}$  inch about six weeks before this admission. Some of the wire was removed. Has pain at site, especially on coughing. Filigree removed under local anæsthesia October 31, 1918. November 23, 1918: Operation for repair of ventral hernia. Thirty-eighth post-operative day wound explored under ether. Skin

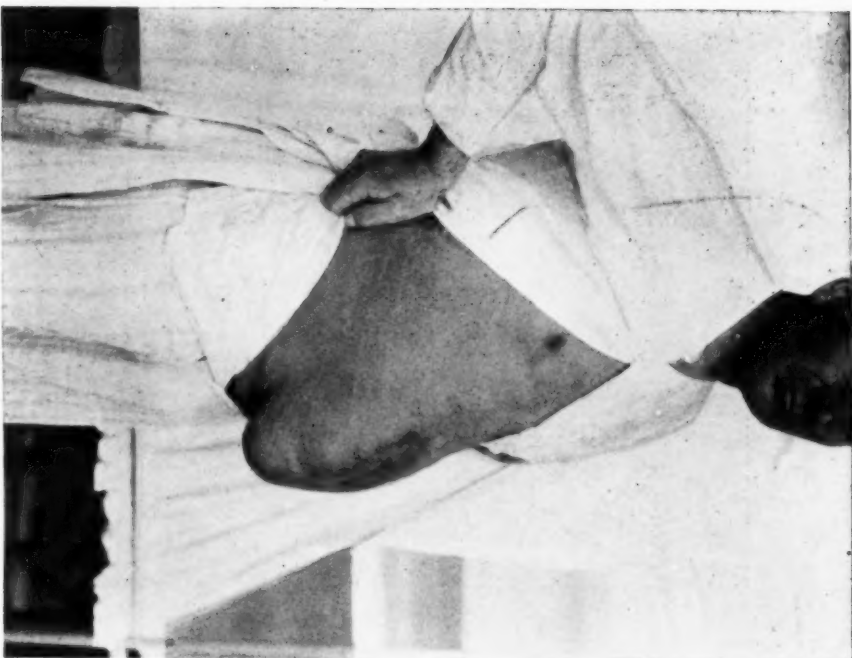


FIG. 3.—Case IIA. Taken September 28, 1915.



FIG. 4.—Case IIB. Taken January 5, 1917.





FIG. 5.—Case III. Photograph taken April 1, 1916.

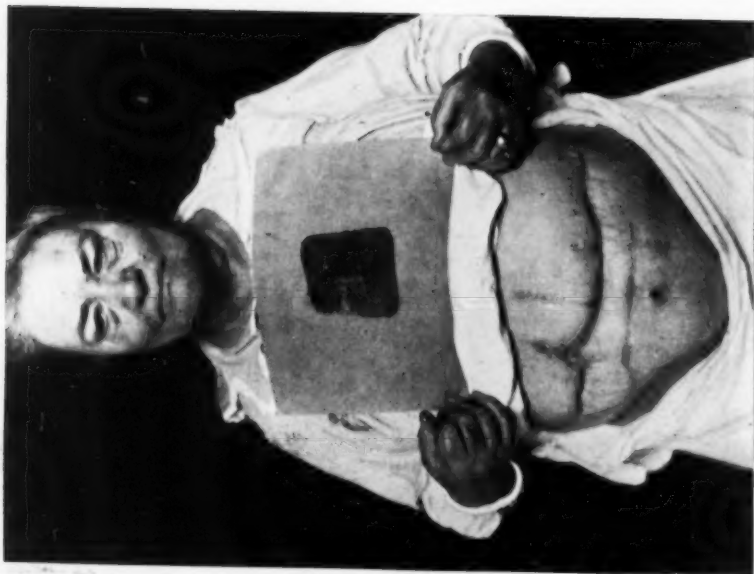


FIG. 6.—Case V. Taken March 30, 1920, showing filigree removed at fourth operation.

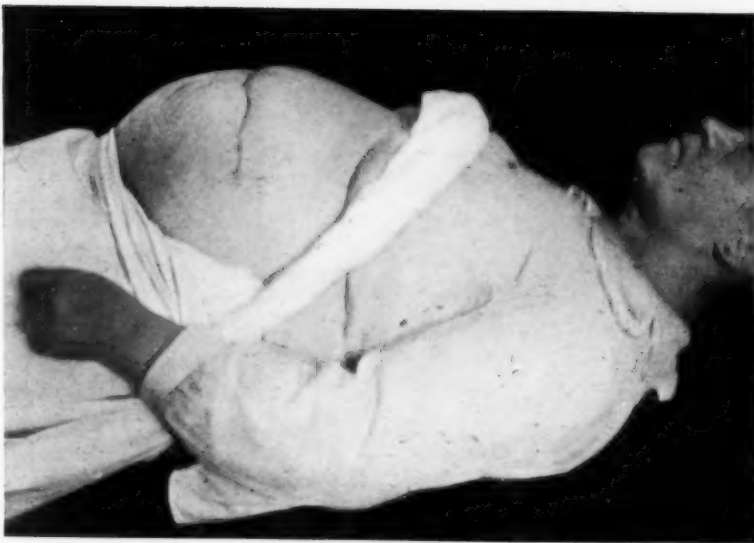


FIG. 7.—Case V. Taken March 30, 1920.

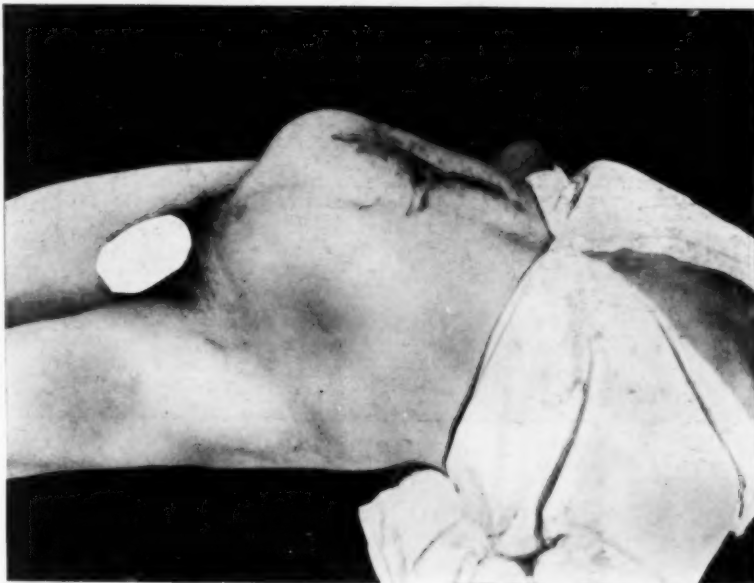


FIG. 8.—Case VIII. Taken November 23, 1919.



FIG. 9.—Case VIII B. Taken April 15, 1920.

## CURE OF LARGE VENTRAL HERNIA

tunnelled along line of incision. Involved area widely converted into one large wound which was packed open with balsam gauze. Fifty-first post-operative day allowed up. Fifty-seventh post-operative day still has a small granulating area. Hernia apparently cured. No impulse or bulging on coughing. Abdominal wall firm at site of former hernia. Patient discharged.

*Follow-up Notes.*—May 1, 1919: Firmly healed. Excellent condition. March 30, 1920: Excellent condition. No recurrence.

CASE VI.—M. M., aged fifty years, female.

*First Operation.*—December, 1901: Left salpingectomy for ectopic gestation.

*Second Operation.*—December, 1902: Laparotomy through old scar. Right salpingo-oöphorectomy for salpingo-oöphoritis. Convalescence complicated by fecal fistula.

*Third Operation.*—Readmitted July 7, 1919. Hernia appeared eight or nine years after last operation (1910 or 1911). Two lumps, size of orange, one at each end of incision. Has worn belt ever since she first noticed them. Operation July 8, 1919. Discharged August 10, 1919. Wound healed by primary union.

*Follow-up Notes.*—June 1, 1920: Excellent result. No bulging.

CASE VII.—B. W., aged fifty-eight years, male.

*First Operation.*—One year before second operation. Extensive operation for cholelithiasis. Wound broke down and hernia developed two months later.

*Second Operation.*—Examination: Very large individual. Ventral hernia size of child's head at term through scar in midline, reaching from umbilicus to ensiform. Operation May 23, 1919. Operation attended with much difficulty, lasting two hours and a half.

*Follow-up Notes.*—August 1, 1919: Patient writes that he is exceedingly well. Later but indirect reports indicate continuance of good result.

CASE VIII.—M. Z., aged forty-eight years, male.

*First Operation* (1914).—Operation for gall-stones.

*Second Operation* (1916).—Operation for ventral hernia which appeared six months after last operation.

*Third Operation* (1918).—Operation for recurrent ventral hernia. Hernia appeared three months after last operation.

*Fourth Operation* (November 26, 1919).—On twenty-sixth post-operative day considerable discharge. There is a sinus which extends upward and to the left. Counter incision made. Drainage. Fortieth post-operative day discharge stopped. Small sinus at either angle. Forty-sixth post-operative day: Discharged.

*Follow-up Notes.*—February 26, 1920: General bulge, but apparently not recurrence. March 22, 1920: Little recurrence in midline and some bulging without protrusion at site of releasing incision on left side.

## CANCER OF THE OVARY INVADING THE SIGMOID FLEXURE \*

BY PHILEMON E. TRUESDALE, M.D.

OF FALL RIVER, MASS.

APPROXIMATELY 3 per cent. of cancer deaths in females result from malignant disease of the ovaries. This is about one-tenth as many deaths as are recorded from cancer of the uterus, but Taylor<sup>1</sup> observes that it does not correctly indicate the frequency of malignant disease of the ovaries because many more of these cases are cured than of cancer of the uterus.

From the Annual Reports of the Massachusetts General Hospital for six years (1914-1919) it was found that there were 29 cases of cancer of the ovary among 758 cancers in females, and approximately 5500 laparotomies performed on females for all causes. Of these 29 cases 16, or 55 per cent., were found to be inoperable when examined by laparotomy.

In the reports from the Mayo Clinic for a period of five years (1914-1918) there were 150 operations for cancer of the ovaries and 26 "exploratory" operations for the same cause among 5175 laparotomies for diseases of the uterus, tubes, and ovaries.

Among 1700 abdominal sections for diseases of the female organs in our clinic at Fall River, 30 cases of cancer of the ovary were found. During the same period there were 250 cases of cancer in women, making the relative frequency of ovarian cancer 12 per cent. in our records. Of the 30 cases examined by abdominal section 17, or 56.6 per cent., proved to be inoperable.

The average duration of illness, *i.e.*, discovery of a tumor or complaint of pelvic trouble, in our series was nineteen months.

Twenty-one of the patients were married and 9 were single. The relative ages were as follows: Twenty to thirty, 3; thirty to forty, 6; forty to fifty, 9; fifty to sixty, 5; sixty to seventy, 7.

The important feature in the study of these records is the high percentage of cases of cancer of the ovary found inoperable when examined by laparotomy. Add to these figures the number of cases classified as inoperable upon physical examination, on account of palpable metastatic nodes and ascites, and it becomes clear that the disease is more common than present statistics show. Occurring, as it does, most frequently within the period of the menopause, the moderately discomforting symptoms of the early or midperiod of the disease are too frequently ignored.

Ovarian cysts are sign-posts of cancer and their dangers will continue to be disregarded until the frequency of their inoperability is given wide publicity. The root of the difficulty lies in the unwarranted fear of operation, the false sense of security enjoyed by women carrying painless

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\* Read before the American Surgical Association May 4, 1920.

## CANCER OF THE OVARY AND SIGMOID FLEXURE

tumors, and occasionally an almost entire absence of symptoms in the early stage of ovarian cancer.

A pelvic tumor in a woman of cancer age cannot be "watched" with impunity any more than a tumor of the breast. "Watching" tumors until there was abundant evidence of malignancy resulted in an increase in cancer deaths from 66.9 per 100,000 in 1900 to 92 per 100,000 in 1915. Fewer women and fewer doctors now make a business of "watching" tumors, and the percentage of cancer deaths has not increased since 1915. Yet the fact that in the average hospital more than 50 per cent. of the cases of ovarian cancer are found to be hopeless at the time of operation opens up a small field, at least, in which a reduction can be made in the total deaths from cancer. This can be done if every easily palpable pelvic tumor, especially the ovarian cyst, is looked upon as potentially cancer and extirpated without inordinate delay.

*Origin.*—The precise origin of cancer of the ovary is still a mooted question. The subject is so intricate and so laden with theoretical dogma that the authors of gynecologic pathology frequently record their observations and allow the reader to make his own interpretation.

Goodall has made an intensive study of the origin of ovarian tumors, publishing the results of his investigations in 1911<sup>2</sup> and again in 1920.<sup>3</sup> From his contributions a more intelligent understanding of the genesis of ovarian cancer is obtainable. In his study of the comparative embryology, histology, and function of the cow's ovary which bears a close resemblance to the human, Goodall expresses the belief that epithelial tumors of the ovary do not spring entirely from fetal rests, but that they do arise from postnatal structural defects as well. In nearly every ovary in women over thirty-five years of age he observed a dipping of the germinal epithelium into the deep crevices over the whole surface of the ovary owing to the cicatrization of the corpora lutea; and in this same class he demonstrated the resolution of the corpora to be less rapid and less complete, and marked by fibrosis and scar. On the contrary, in the child resolution is complete without shrinking or mutilation of the ovary or its surface. Therefore it seems fair to assume that, while cancer finds its origin in the primordial follicles deep in the ovary, many tumors arise from the intractions of the germinal epithelium in the cicatrization of the corpora lutea. When the cells of the corpora lutea proliferate they occasionally lose all signs of epithelial arrangement, and when they give rise to neoplasm they develop an interstitial cell growth histologically sarcoma rather than carcinoma.

A striking feature in connection with the malignant tumors of the ovary is the mixed character of the tissue growth. Several types may exist in the same specimen. The tissues may change almost imperceptibly from carcinoma to perithelioma and then to sarcoma, a process which in itself indicates the complexity of its birth cells. In the fœtus and child the ovary is frequently found lobulated, and the sinking of the



germinal epithelium into the primitive deep clefts gives rise to cysts which sometimes degenerate into cancer in later life. What the agent is that provokes this change remains an enigma. One thing is clear—that the defense against cancer growth possessed by the tissues of early life is lost and a local irritation only is needed to produce a cell activity in structures which are prone to take on aberrant growth.

The cystic carcinomata commonly arise in cystadenoma or the papillomatous varieties. They do not attain a very large size, and before removal they frequently are not recognized as malignant unless the papillomatous growth has extended through the wall of the tumor to invade the peritoneum. When this happens the true character of the growth is revealed by its exuberant vegetation giving rise to peritoneal and other metastases.

The attempt to classify ovarian neoplasms has proved so difficult that the older writers were content to divide cancer into two forms, the cystic and the solid. This is a practical arrangement from a clinical point of view, though it fails to indicate the embryological or developmental origin of these tumors.

Adami<sup>4</sup> has classified the malignant tumors of the ovary in three types:

1. New growth of epithelial type {
  - a. Cystic carcinoma.
  - b. Solid carcinoma.
2. New growth of connective-tissue type {
  - a. Endothelioma.
  - b. Perithelioma.
  - c. Sarcoma.
3. Mixed tumors {
  - a. Myosarcoma.
  - b. Adenosarcoma.
  - c. Sarcocarcinoma.
  - d. Cystic carcinoma.
  - e. Cystic sarcoma.

*Symptoms.*—The symptoms of carcinoma of the ovary vary widely according to the size of the tumor, its rapidity of growth, and the degree of encroachment upon adjacent organs. When cancer is the result of degeneration of an ovarian cyst the symptoms may be those of the cystic tumor only, which are usually a feeling of fullness and weight in the abdomen. When carcinoma becomes superimposed there may be constitutional symptoms, such as loss of weight, interference with appetite, digestion, etc. Symptomatic evidence of cancer of the ovary may be very vague even in the mid-period of the disease. Cachexia and ascites are usually symptoms of inoperability.

*Prognosis and Treatment.*—The outlook for favorable results in dealing with cancer of the ovary depends upon the extent of growth before the standard operative treatment of complete removal of both ovaries is adopted. Since ovarian cyst is a known precancerous condition, this type of tumor should be removed when found, and its extirpation should



FIG. 1.—Case No. 2170. Showing large ovarian tumor adherent to fibroid uterus, omentum and bowel. Blood-vessels from the adjacent structures are seen entering the periphery of the rapidly growing tumor.



## CANCER OF THE OVARY AND SIGMOID FLEXURE

be accomplished always without rupture of the cyst wall. Peritoneal metastasis, proving rapidly fatal, may result from spreading the excrescences of malignant papillomata over the peritoneum. Prompt examination of an apparently benign cyst should be made for malignant changes while the abdomen is open. Whenever new growth is found the other ovary, potentially cancerous, should also be removed, because it is common knowledge among pathologists that when fetal rests occur in one of the bilateral organs they are always present in the other.

The papillary type is often of a low grade of malignancy, and although it is found disseminated over the peritoneum, the use of radium and X-rays after the removal of both ovaries will retard, if not cure, the condition.

The prognosis in solid carcinomas of the ovary, which are also unilateral or bilateral, is not so good, inasmuch as they frequently metastasize before they are discovered. Graves<sup>5</sup> describes this form as genuine idiopathic carcinoma which develops directly from previously unchanged ovarian tissue. They are rare and frequently found to be inoperable. This form is usually of the medullary type, but may be scirrhous or myxomatous. According to Nicholls,<sup>6</sup> the ovarian tissue is frequently diffusely infiltrated or destroyed or the main mass of the organ may be pushed to one side in the course of growth. The solid tumor, though usually small, may attain the size of a child's head. On account of the rapid growth, blood supply at the periphery of the tumor may become inadequate and the vitality of its tissue is sustained by adhesions to the parietal peritoneum, intestine, and omentum. Such a condition was found to be the condition in the following case:

CASE I (No. 2170).—Admitted to our hospital in Fall River, Mass., March 7, 1915, aged forty-nine years, single.

The patient had known for years that she had a tumor in the lower abdomen. From this she had suffered no special discomfort until October, 1914, when there developed a feeling of fullness and pressure in the lower abdomen. Indigestion supervened in the form of distress at varying intervals after eating, anorexia, flatulence, sour stomach, and obstipation. During the last three months she noticed a rapid increase in size of the tumor in the left side of the lower abdomen. Her physician had advised operative treatment several months ago and, suspecting malignant disease, he now prevailed upon her to report for operation. She had lost 40 pounds in weight in six months.

Physical examination revealed no disease other than a tumor occupying the lower abdomen. It consisted of multiple solid growths arising in the pelvis, apparently uterine fibromata. On the left side an oval, smooth, solid tumor had reached the umbilicus. The entire mass had a very narrow range of mobility.

The operation revealed multiple fibroids of the uterus crowded to the right side by a solid tumor of the left ovary about the size of a cocoanut. This tumor was the fixed portion of the entire mass.

It was involved in adhesions to the parietal peritoneum, descending colon, omentum, and loops of small gut. The picture presented did not invite interference except for the reason that the ovarian tumor had the appearances of malignancy. There was very little free fluid and no metastatic nodes were discovered within the abdomen or elsewhere. Therefore, a considerable operative risk for the eradication of the disease was deemed justifiable. A sub-total hysterectomy was done. The adhesions to the ovarian tumor were unusually vascular, indicating the proliferation of numerous small vessels to sustain the vitality of the tumor. For a distance of 10 cm. the growth had invaded the descending colon, destroying the coats of the bowel. About 30 cm. of the colon was excised with the tumor. The distal stump of the bowel was infolded with a purse string of fine silk. An artificial anus was made with the proximal end. Aside from the troubles incident to a recent colostomy, the convalescence was uneventful.

Two years later, in March, 1917, the patient's general state was very satisfactory. There was no evidence of recurrence and she requested that the normal outlet of the colon be restored.

On March 19, 1917, the second laparotomy was done. After opening the abdomen no return of the disease was discovered and the field surveyed with the purpose of making an end-to-end anastomosis of the colon. This seemed impracticable owing to the wide separation of the opposing ends of the colon and the firm adhesions in the left upper quadrant of the abdomen. A workable alternative was in plain view by the juxtaposition of the head of the cæcum and the blind end of the rectum. Between the two a lateral anastomosis was made. Under these conditions the function of the large bowel became a source of interest. In spite of a competent anastomotic opening between cæcum and rectum, the normal one-way passage of intestinal contents continued by evacuation of the bowel through the artificial anus. This could not be considered extraordinary while there was the resistance at the anus of a closed sphincter muscle; but the result was the same when a tube of large calibre was placed in the rectum. An enema given through the artificial anus returned in the presence of a closed rectal sphincter, but passed out through the indwelling rectal tube. A little later enemas given by the artificial anus returned, and it seemed probable that the anastomotic opening had closed. An examination with the sigmoidoscope revealed the communication adequate. Therefore it was deemed wise to resect the colon. This was done, leaving the cæcum with its sutured end suspended in the lower angle of the abdominal incision. An indwelling rectal tube was employed to relieve back pressure. This tube was removed in ten days. About a week later a fecal fistula developed which closed spontaneously after two months.

The patient is now well, five years after removal of the growth, and the result makes justifiable an occasional excision of wide proportions in the presence of an extension of cancerous growth by contiguity.

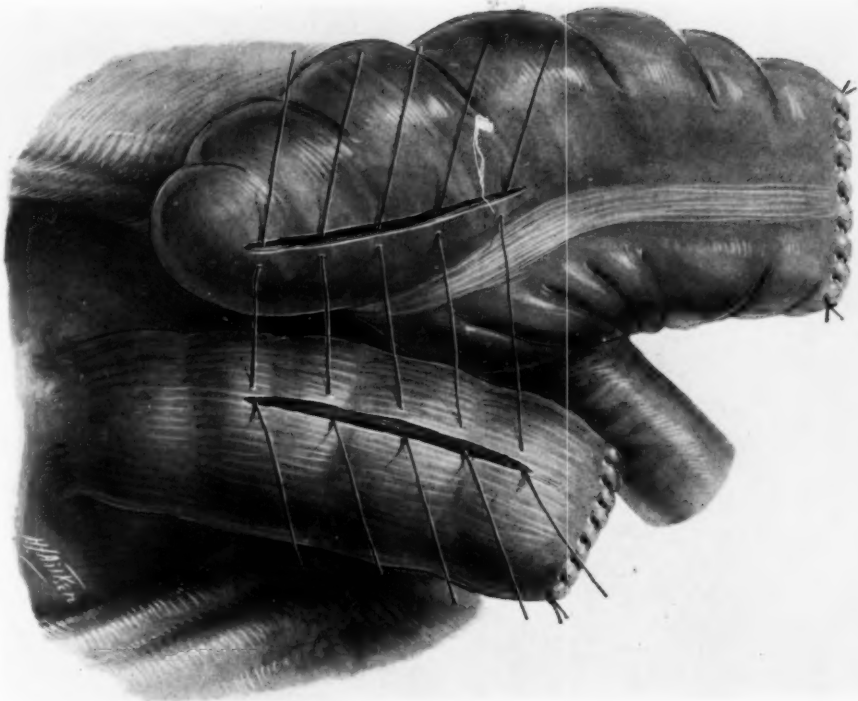


FIG. 2.—Case No. 2170. Anastomosis between the cecum and the severed end of the rectum.

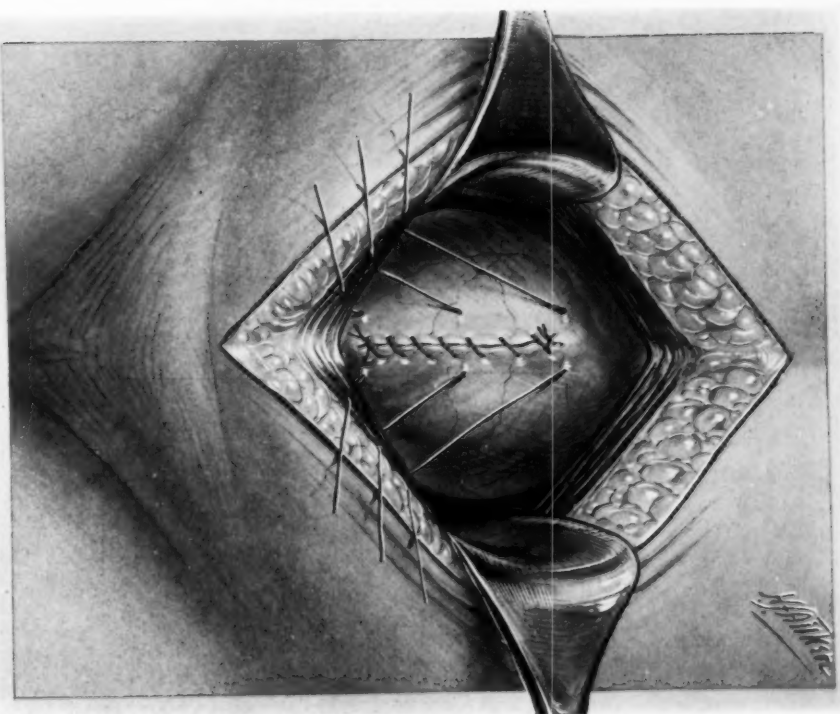


FIG. 3.—Case No. 2170. Stump of cecum suspended in the lower angle of the abdominal incision.



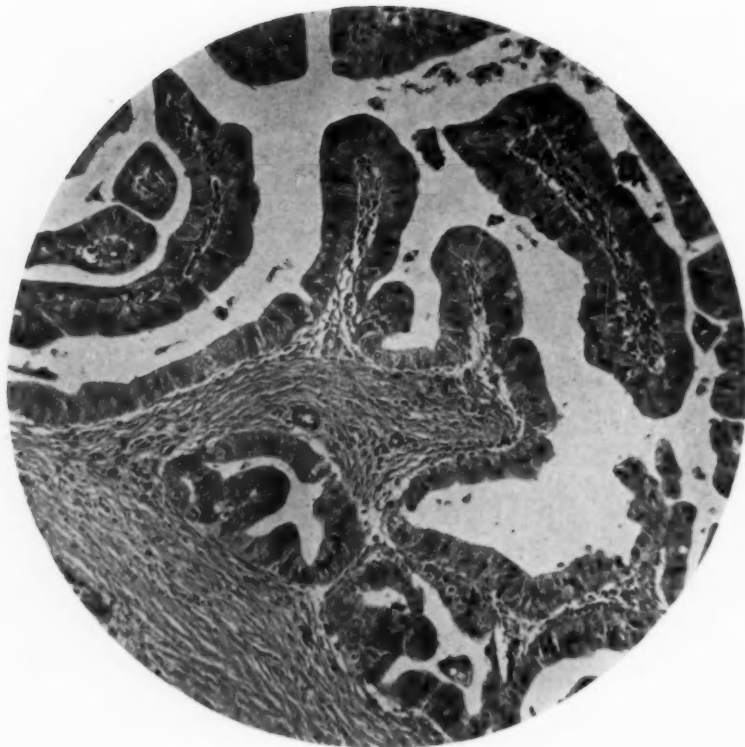


FIG. 4.—Microphotograph, Case No. 2170. Cylindrical type of epithelium resembling that of the intestinal mucosa.



FIG. 5.—Microphotograph, Case No. 2170. Same type of tissue growth combined with ordinary adenocarcinoma; the cells are arranged in solid cords, with bare suggestion of a lumen.



FIG. 6.—Microphotograph, Case No. 2170. Undifferentiated epithelium, with masses of connective-tissue stroma between alveolar groups of cancer cells.



FIG. 7.—Microphotograph, Case No. 2170. The cuboidal and tubular form of cell arrangement suggesting that of convoluted tubules in the kidney.



FIG. 8.—Microphotograph, Case No. 2170. Tubular arrangement not evident: (a) The cells have become vacuolated, suggesting adrenal structure; (b) groups of plasma cells in the stroma.



FIG. 9.—Microphotograph, Case No. 2170. Rapid growth of the tumor is observed here in the appearance of numerous mitotic figures in areas where the cylindrical type of epithelium prevails; (a) monaster; (b) disaster.

## CANCER OF THE OVARY AND SIGMOID FLEXURE

It is hoped that the report of a case of this character, with its complications and hazards and the suffering entailed with good luck in pursuit, will serve as a reminder that "a stitch in time will save nine," and that the average woman, even of the intelligent class, is not yet aroused sufficiently to the importance of early examination for pelvic disorders and the wisdom of adopting prompt surgical measures for the removal of pelvic and abdominal new growths.

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- <sup>3</sup> Goodall: Surgery, Gynecology and Obstetrics, March, 1920.
- <sup>4</sup> Adami: Adami and Nicholls, Principles of Pathology, p. 854.
- <sup>5</sup> Graves: Graves' Gynecology, p. 339.
- <sup>6</sup> Nicholls: Montreal Med. Journal, vol. xxxii, 1903, p. 326.

## THE RADICAL TREATMENT OF X-RAY BURNS\*

By JOHN STAIGE DAVIS, M.D.  
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X-RAY burns were quite common when long exposures were necessary to secure satisfactory plates, and before the methods of protecting patient and operator were understood. They are now comparatively rare, but during the last ten years I have had a number of them referred to me, and can recall several occasions when I have had three or four such cases in the hospital at one time.

These burns are usually caused by the use of X-rays in the treatment of skin lesions, such as psoriasis, eczema, and superficial epithelioma; by frequent exposures extending over a long period of time in the treatment of inoperable or incompletely removed carcinoma; by the reckless use of the apparatus in the hands of unskilled operators, and by long fluoroscopic exposures.

I have had under my care burns situated in almost every region of the body.<sup>1</sup> Some of them have been of the first degree, where the skin is reddened; a few of the second degree, where blisters formed; but the vast majority have been of the third degree, where the full thickness of the skin and often the underlying tissues were involved. It is the latter group in particular that I wish to consider in this paper.

A peculiarity of an X-ray burn is that considerable time may elapse (several weeks or months) before the extent of the damage done becomes apparent. Some very severe burns have followed single exposures, others have been the result of multiple exposures. One patient in my series had been given more than 450 treatments scattered over several years; another had fifteen-minute exposures every day for nine months, and several others had more than 100 treatments. Some of the deeper burns had existed from a few weeks to as long as fifteen years before coming under my care.

On inspection the burned area may be considerably hollowed out. The skin is hairless and atrophied, smooth, dry and shiny, with or without a blotchy brownish pigmentation. In the majority of cases there are characteristic telangiectases which may be discrete, or occur in reddish patches. Punctate hemorrhages due to rupture of dilated capillaries may be present.

On palpation the tissue is hard and board-like. Its outline where it merges into surrounding skin may be quite irregular. Occasionally the entire area is covered with a sharply differentiated brown mummified tissue.

The ulcers may be superficial, or may involve the full thickness of the skin, with a considerable depth of the underlying soft parts.<sup>2</sup> The history

\* Read before the American Surgical Association, May 4, 1920.

<sup>1</sup> Scalp, face, neck, chest, back, shoulder, arm, forearm, hand, abdominal wall, penis, thigh, leg and foot.

<sup>2</sup> I have seen the entire thickness of the abdominal wall involved in a burn.



## THE RADICAL TREATMENT OF X-RAY BURNS

of many of them is that they heal slowly and then break down, this process being repeated over and over. Some of the ulcers never heal without operative interference.

There is usually an irregular-shaped patch of tightly adherent necrotic tissue occupying the central portion of the ulcer. The edges are thickened and grayish-red in color; are very hard, and are often everted. In fact, the clinical appearance is suggestive of malignancy. From the edges outward to normal skin we find the tissues more or less infiltrated with scar.

Exquisite sensitiveness is characteristic of the deep burns. The pain in an ulcerated area may be due to irritation caused by infection, which is always present; to changes in the nerves themselves, or to pressure on the nerves by scar tissue. Any one or all of these conditions may exist. Addiction to narcotics is not uncommon, as the burning pain, even from a tiny ulcer, may be severe and continuous. There may be intense pain, making operative interference necessary, after spontaneous healing has taken place. This pain in a healed burn may be due to nerve changes, to pressure by scar tissue, or to both conditions.

There is said to be a marked tendency to malignant degeneration in chronic X-ray burns, but my experience has been that this tendency is no more marked in these burns than in any other chronic ulcer.

Microscopic examination of the excised tissues in all my cases, where the full thickness of the skin was involved, has been negative for malignancy.

Dr. J. C. Bloodgood sends me the following report after study of the excised tissues: "The characteristic features in an X-ray burn as compared to a leg ulcer, or any other type of simple ulcer are: X-ray keratosis at the edge of the ulcer with atypical down-growth of epithelium, with or without pearly body formation; a very superficial zone of cellular granulation tissue; unusual scar tissue formation which, as a rule, extends to the muscle; thickening of the walls of the blood-vessels with endothelial obliteration, and minute abscess formation beneath the surface of the ulcer."

There is, however, a distinct tendency toward malignant degeneration when chronic ulceration follows the breaking down of a patch of keratosis, such as we find on the hands of the pioneer röntgenologist. Two such cases have been under my care. In both, the axillary glands are involved and were removed. In one case, too short a time has elapsed to predict the ultimate result, but in the other there has been no recurrence after the lapse of a number of years.

*Treatment.*—Recent X-ray burns of all degrees should be treated as ordinary burns, but unless there is a fairly prompt response to such treatment it is a mistake to continue it.

Palliative measures should be used in burns of the first degree. Paraffin films are often comforting; painting with collodion, or the application of sterolin,<sup>\*</sup> or some bland ointment, are useful procedures.

<sup>\*</sup> FORMULA.—Balsam of Peru, 4 c.c.; castor oil and Venetian turpentine, of each, 2 c.c.; alcohol (95 per cent.), 100 c.c.



Burns of the second degree, where there is blistering, have been quite rare in my series, although I have in mind one case in which both hands had been treated several times for localized sweating of the palmar surfaces. Blistering began about one week after the last exposure, and the entire skin of each hand came away like a glove after about two weeks.

It is difficult to tell at first the depth of such a burn, as one which seems to be merely blistered will turn out to be much deeper in places after the blisters have been removed. I have found that wet dressings have been more comfortable in these cases than paraffin or ointments.

In burns of the third degree which do not heal promptly and permanently by the usual methods, we must adopt a more radical procedure. The ulcer and surrounding area of induration should be excised with a wide margin out to and down to healthy tissue. It is impossible to tell the depth of the destructive process until excision is done.

The tissues are of extreme hardness and will often turn the edge of a scalpel. The subcutaneous fat may be completely destroyed, but if present is a deep yellow color and is very firm and resistant due to scar tissue involvement. In deep burns the muscle may be entirely replaced by dense scar tissue, or there may be varying degrees of infiltration with scar. The bleeding is always marked after excision and is often difficult to check as there is general oozing from all portions of the wound.

After excision, the defect should be grafted immediately if the base of the wound is of normal tissue, but if doubtful tissue is left (owing to the impossibility of complete excision), grafting should be deferred until granulations form. The type of graft used should depend upon the situation. I use "small deep grafts" in the majority of instances, but have used with satisfaction Ollier-Thiersch, or whole-thickness grafts in selected positions.

Pedunculated flaps from neighboring tissues, or from a distant part, have been of great use in situations where a pad of fat, in addition to whole-thickness skin, was necessary.

The best method of relieving the pain, aside from the excision of the affected area, is to divide the nerves supplying the area.

X-ray or radium have been used in the treatment of X-ray burns, and several patients have come under my care who had been treated in this way. I have seen no benefit follow such treatment.

Patches of keratosis which exist on the X-ray operator's hand, following frequent exposures without protection, may be successfully treated by freezing with carbon dioxide ice. This is a tedious and painful process. Radium may be used with success, but the reaction is also painful. In my opinion it is less safe than the carbon dioxide ice. Should the patches of keratosis ulcerate, neither of the methods just mentioned should be employed. Complete excision with immediate or subsequent grafting is then the method of choice.

*Comments.*—X-ray burns often cause complete loss of function of a part.

## THE RADICAL TREATMENT OF X-RAY BURNS

In more severe burns of the hands, one is struck by the rigidity of the fingers due to involvement of the tendons and overlying soft parts, and even of the joints themselves.

In those instances in which tendons have been destroyed it is advisable to fill the defect with a pedunculated flap of skin and fat, and later to restore the tendon by the method best suited to the particular case.

Where large areas are involved we seldom excise sufficient tissue, and I have noticed that infection sometimes occurs in the margins of these wounds. Occasionally there is sloughing of the entire margin of the wound, although the excision has been apparently complete, and for this reason alone it may be wise to defer grafting, or the transference of a flap.

Fulminating infections occur in areas of skin which have been burned by X-rays. Prompt excision with a generous margin is indicated, or even amputation of the part may be necessary to control the rapid spread of the infection.

The after-results of excision with grafting, or flap shifting, have been most gratifying. I have no record at the present writing of a case in which a breakdown has followed the thorough application of the method. Furthermore, function is restored in many instances and patients who have been incapacitated for years have been returned to their former activities.

## ETIOLOGY, PATHOLOGY AND CLINICAL FEATURES OF BENIGN EXOSTOSES \*

BY ELLSWORTH ELIOT, JR., M.D.

OF NEW YORK, N. Y.

NUTRITIVE disturbances and traumata have long been recognized as important factors in the etiology of exostoses. In the former, exostoses, occasionally multiple, spring from those epiphyses which are chiefly concerned in the growth of the bone and not infrequently disappear when the nutritive disturbance is relieved or corrected. Exostoses due to trauma include chiefly those resulting from the irritation of long-continued friction such as may be observed in a persistent horseback rider, either at or near the inner surface of the lower epiphysis of the femur. The clinical features of these two groups of exostoses are so well known as to require no further consideration, although, in passing, it may not be amiss to call attention to the fact that exostoses arising from the epiphysal line, in the subsequent growth of the bone, gradually become separated from it, in that the actual point of origin of the growth remains stationary while the epiphysal cartilage proper recedes.

The study of the effect of acute trauma at a distance from the epiphysal line, and even at a time when the full growth of the bone has been attained, is not without considerable interest.

Contusion of the bone, like that of the overlying soft parts, causes a variable rupture of blood-vessels with the escape of blood in the direction of least resistance. In contusion of bone this extravasated blood collects beneath the periosteum, usually in such small quantities as to cause no perceptible swelling. Subsequently, as in the soft parts, the clot is usually absorbed, although more slowly, and at times not without leaving slight permanent irregularities in the contour of the bone due to the calcification of its unabsorbed portion. A gradually subsiding tenderness with, in exceptional cases, a distinct though slightly elastic swelling, are its only symptoms, and ordinarily there is little interference with locomotion or other use of the extremity.

Rarely, however, as in the case herewith reported, after a more or less localized trauma, a tender swelling develops, involving a considerable portion of the bone, which is very sensitive to the touch and deeply elastic in consistency. While this swelling does not usually suppurate, the absorption of the extravasated blood may not readily take place, and its persistence together with its gradual calcification may cause such a degree of discomfort that the patient is impelled to seek relief. In the absence of suppuration a permanent thickening of the bone, corresponding to the extent of the

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## BENIGN EXOSTOSES

hæmatoma, may ultimately be expected, differing only in degree from what ordinarily takes place in the mild type of this lesion. These permanent bony irregularities, of variable size, can in no wise be classified with pointed exostoses, although resembling at times the so-called ivory variety, commonly seen in the skull, which by some is considered to be of a traumatic origin.

It is quite possible, however, for a subperiosteal hæmatoma of the smallest size to prove the starting point of a more or less actively growing pointed exostosis that can not be differentiated either pathologically or clinically from the classic pointed exostosis, the result of continued and repeated friction. The rapidity of growth of an exostosis from such an origin even though based, as in the present instance, upon a single case, is particularly worthy of mention. As a class benign tumors, especially those of bone, are of slow growth. In the case referred to, however, the pointed exostosis reached a length of two inches within thirteen months, an extremely rapid growth, and the fact that friction played no part in this unusual phenomenon is demonstrated by the statement of the patient as well as by the failure of any bursa to develop over its pointed apex. While a rapid increase in size is the rule in malignant growths and may be expected in those exceptional benign tumors which undergo malignant change, the benign character of the exostosis in question was positively demonstrated by a subsequent careful microscopical examination.

Male, aged twenty years, December 15, 1915. Two and one-half months ago, while playing football, patient was kicked in the right thigh. This was immediately followed by swelling involving the entire thigh and knee and confining patient to bed for one week. At the end of that time the acute pain and disability had subsided and there remained of the swelling only that part in the middle of the thigh on its outer and anterior aspect which, about four inches long, persisted up to the present time with only slight decrease in size, although it became gradually of firmer consistency. During this interval patient has suffered from considerable pain and discomfort, especially on walking and on attempting to flex the knee. The pain has been worse at night. For the first part of this period patient walked with crutches and latterly with a cane, there being a perceptible limp.

All attempts to relieve the pain and bring about the absorption of the swelling by massage and various forms of counter-irritation having proved futile, the patient insisted on operation. Under ether, through an incision four inches long on the outer anterior aspect of the thigh, the periosteum was exposed. It was considerably thickened and on division of its outer layer an oval cavity filled with a mass of rather friable calciferous tissue and about three-quarters of an inch thick, gradually becoming thinner at either extremity, was disclosed. The demarcation between the inner layer of the periosteum and the superficial surface of this mass was well defined and easily separated with the finger. The same condition was found to exist between its deeper sur-

face and the adjacent layer of compact bone, so that the removal of the mass was accomplished without difficulty and in a satisfactory manner. After suture of the divided periosteum the muscular layers were closed with chromic gut, a small rubber drain being left *in situ* for twenty-four hours. Primary union was obtained and the patient was completely relieved of all discomfort.

Pathological examination of the removed tissue showed a trabeculated formation calciferous tissue, attached to which were strands of dense connective tissue. Between the trabeculae there had been extensive hemorrhages. No evidence of infection.

Ten months after this operation patient first noticed intermittent burning sensations in the thigh and as these became more frequent an X-ray was taken three months later. This disclosed a typical pointed exostosis about two inches in length projecting from the outer aspect of the femur opposite the lower extremity of the scar. This was found on operation to arise from the femur at a point corresponding to what had formerly been the lower end of the organized subperiosteal clot and was easily removed. There was no bursa over its irregularly pointed extremity and the bone directly above and the site of the former clot presented a normal appearance.

A microscopical examination of the exostosis differed in no particular from that ordinarily found in that condition.

The patient was relieved of all discomfort and has had no trouble since.

While clinical observations of an unusual character are necessarily void of scientific application, they are not, however, without a certain interest, and perhaps, in the present instance, the possibility of such a clinical history in a bony exostosis may prove of some value in adding another type of benign tumor to those of vascular character which, although they may exceptionally show a rapid growth, must still be retained in the benign class.

## SARCOMA OF THE CLAVICLE—END-RESULTS FOLLOWING TOTAL EXCISION \*

BY WILLIAM B. COLEY, M.D.  
OF NEW YORK, N. Y.

IN a paper read before the meeting of the American Surgical Association in Washington, May, 1910, I reported a case of total excision of the clavicle together with ten other cases of sarcoma of the clavicle that had come under my personal observation. Adding to these the cases which I was able to find in the literature, I reported a total of 63 cases, nearly all of which had been treated by total or partial resection. In many of the cases the end-results were not known. Only 2 were traced that had remained well beyond the four-year period.

In 1912 Johansson (*Deutsche Zeitschr. f. Chir.*, vol. lxxviii, 1912) found 32 cases in the literature that had not appeared in my list of previously collected cases, and, in addition, he published 3 cases that had come under his own observation.

Kalus (*Inaugural Dissertation*, Royal Univ. of Greifswald, 1912) has also reported two cases since the publication of my earlier paper on the subject.

In addition to these, I have had under my own observation since that time 5 other cases of sarcoma of the clavicle.

Only 5 of my own series of cases have a direct bearing upon the question at issue: the end-results following total excision of the clavicle. In 2 of these cases the operation was performed by myself, and in the remaining 3 by other surgeons, *i.e.*, Dr. Maurice Richardson, Dr. Huntington, and Doctor Freeman. For a fuller history of these 3 cases I would refer you to my earlier paper on the subject, published in the *ANNALS OF SURGERY*, December, 1910.

CASE I.—*Periosteal round-celled sarcoma of the clavicle.* J. V., male, aged sixteen years, noticed pain and swelling of the left clavicle shortly after a severe strain. The tumor was of rapid growth and involved two-thirds of the inner portion of the clavicle. The diagnosis was established by physical signs and X-ray photographs, without an exploratory operation. On November 22, 1909, I performed a total excision of the clavicle, from which the patient made an excellent recovery. A few days later he was put upon the mixed toxins of erysipelas and bacillus prodigiosus, which were kept up for a period of three months. Almost no deformity resulted from the operation and the patient retained complete functional use of his arm. He served in the Army in France during the war, and at the

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\* Read before the American Surgical Association, May 5, 1920.



time of my last examination, in February, 1918, nearly nine years later, he was in good health with perfect functional use of the arm. Microscopical examination made by Dr. James Ewing.

CASE II.—*Periosteal round-celled sarcoma of the left clavicle.* J. W. H., male, aged thirty-four years, injured the left clavicle in January, 1908, shortly after which a local swelling appeared which grew rapidly. A total excision of the clavicle was done by Dr. Maurice H. Richardson, of Boston, on May 18, 1908, the tumor being so large that the operation was very difficult. As soon as the wound healed the patient was referred to me by Doctor Richardson for prophylactic toxin treatment. The treatment was begun in New York and carried out under my direction by Dr. H. L. Trulock, of Dixmount, Maine, for a portion of two years. Doctor Richardson believed the prognosis so grave from operation alone that he stated in his letter if the man made a permanent recovery he was willing to give the entire credit to the toxin treatment. According to a letter received from the patient at the present time (April, 1920), he is still in good health without the slightest trace of a recurrence, twelve years later. Microscopical examination made by Doctor W. F. Whitney, of Massachusetts General Hospital, Boston.

CASE III.—*Periosteal round-celled sarcoma.* I have performed one other total excision of the clavicle since my former paper, the history of which is briefly as follows: T. M., male, twelve years old, entered the Hospital for Ruptured and Crippled in December, 1912, and was referred to me by Doctor Whitman. The patient had always been well until five weeks previously, when he fell from a step-ladder, the inner portion of the right clavicle striking upon the corner of a wooden box. Two weeks later a swelling appeared at the site of the injury, apparently arising from the bone; no pain, but very rapid increase in size. On December 17, 1912, or three weeks from the time the swelling was first noticed, physical examination showed a large tumor about the size of a hen's egg, markedly protuberant in the region of the sternum and right clavicle, occupying the inner half of the right clavicle and apparently involving the suprasternal region. It was very soft, almost fluctuating in consistence, some areas being denser than others; the superficial veins were markedly dilated. The X-ray photograph showed almost complete destruction of the inner third of the right clavicle. Clinical and X-ray data made the diagnosis so clear that no specimen was removed for microscopical examination. I performed a total excision of the right clavicle on December 20, 1912, with practically no loss of blood, and the patient suffered very little shock. Clinically, the tumor was definitely of periosteal origin. Doctor Ewing's full report of the whole specimen is as follows:

Specimen consists of clavicle which fractured about the middle point, where it runs directly into the tumor mass. Periosteum strips easily, shaft of bone is eroded beneath it. The outer end of clavicle is largely destroyed by tumor growth which has split up layers of periosteum and bone shaft and invaded the

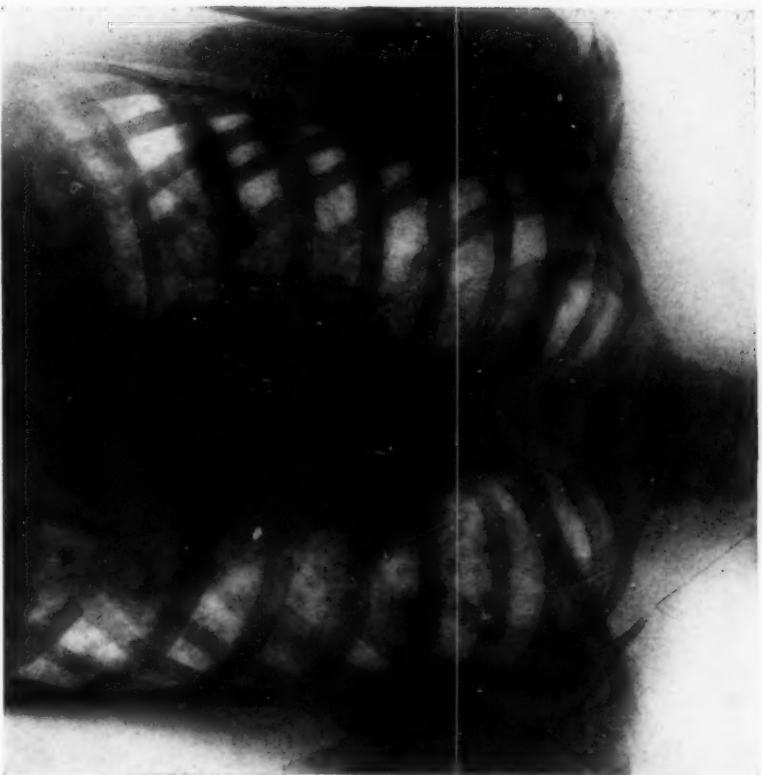


FIG. 1.—Case VI. Two and one-half months after treatment. No evidence of lung involvement at time treatment was begun.

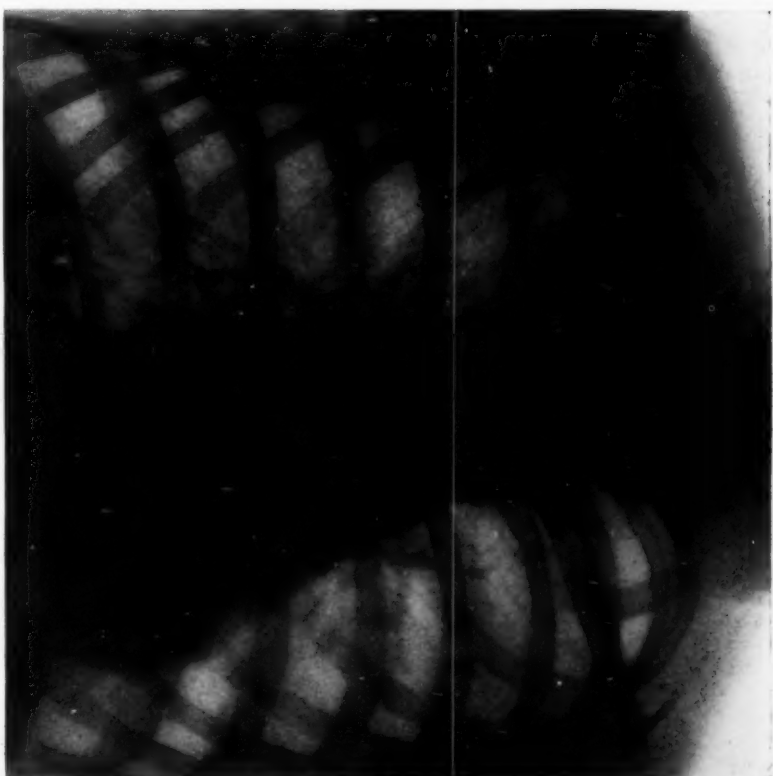


FIG. 2.—Case VI. One month later.



FIG. 3.—Case VII.

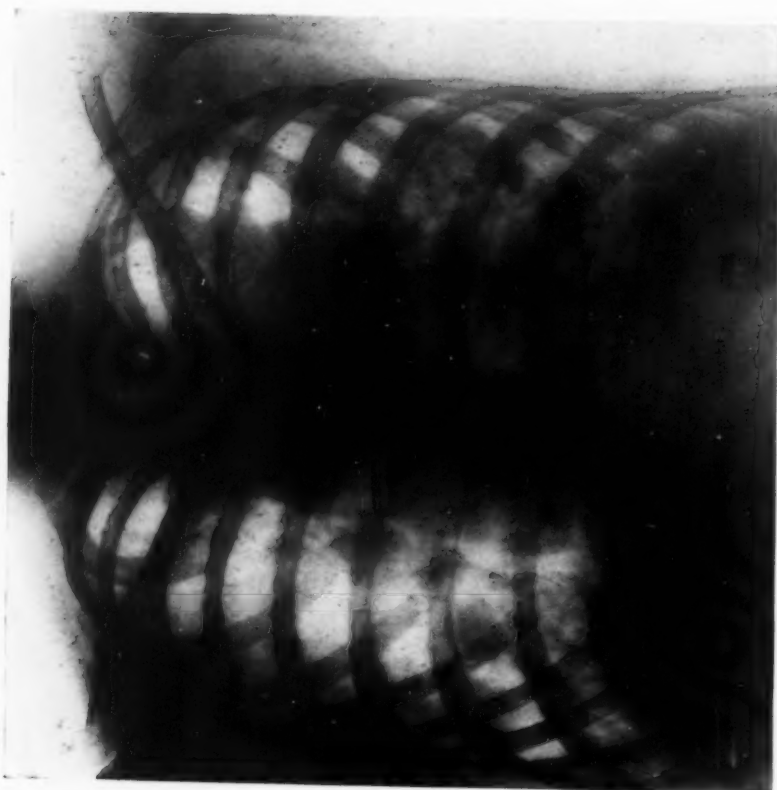


FIG. 4.—Case VII.

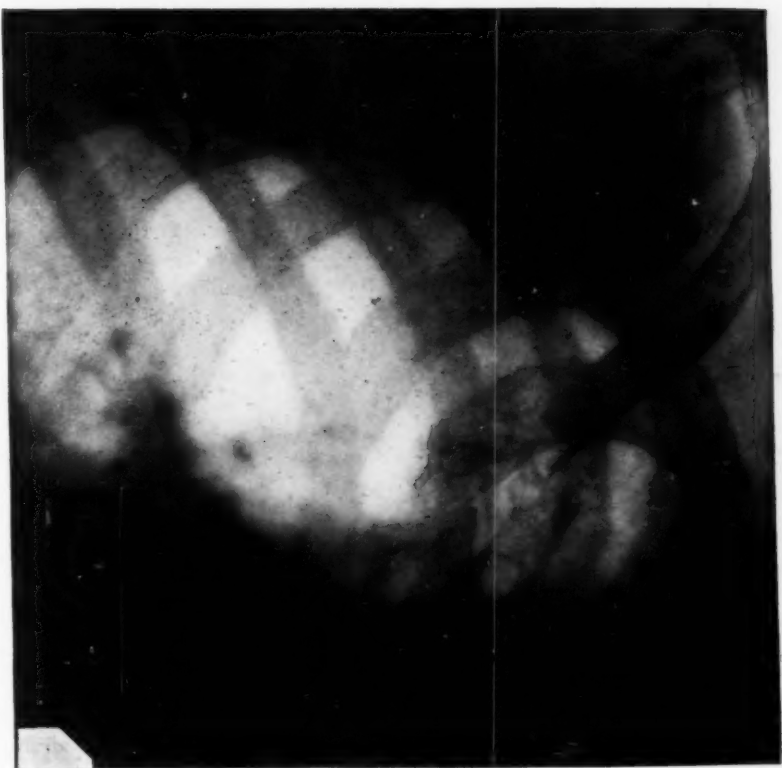


FIG. 5.—Case VII. Four months later.



FIG. 6.—Case VIII.



FIG. 7.—Case VIII.

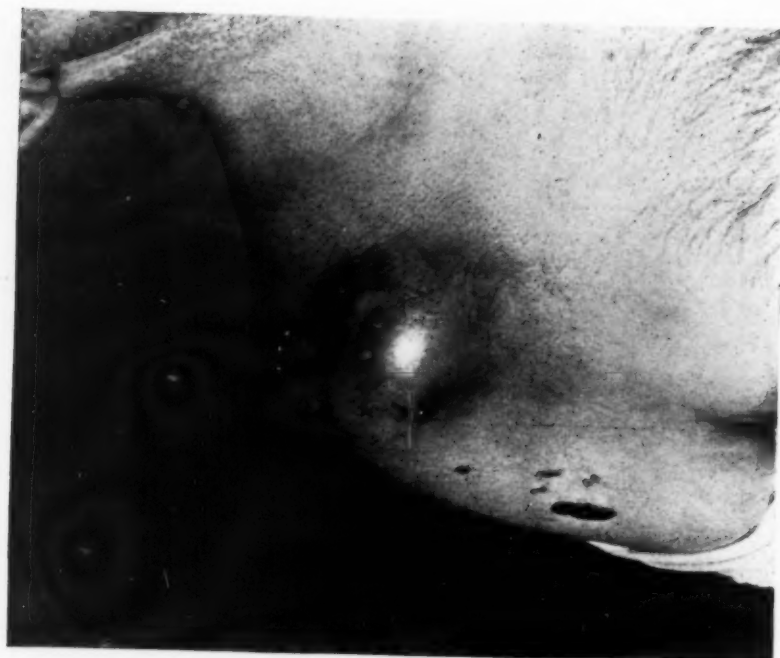


FIG. 8.—Case X.

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surrounding muscle for a distance of  $\frac{1}{4}$  cm., producing a rounded tumor in this region. The gross appearance is not distinctive of either central or periosteal sarcoma. The outer end of the bone is much thickened and the bone is irregularly absorbed. Through the centre of the globular mass of tumor runs a sharp white line indicating periosteum, beyond which the tumor infiltrates muscle and fat.

*Histology.*—The tumor belongs in a class commonly called small round-celled sarcoma. Cells are small, 10-12 micr. in diameter, with poorly defined cytoplasm, hyperchromatic vesicular nuclei. The shape where preserved is polyhedral, cell bodies are clear, arrangement is diffuse, the cells often sheathing numerous small blood-vessels. Size of cells remarkably uniform. One large artery is filled by mural tumor thrombus. Muscle is extensively invaded and destroyed by a diffuse focal growth of tumor cells. Histological indications are highly malignant. Exact source of the cells undetermined.

Ten days after the operation there was a marked swelling at the site of the old tumor having every appearance of a local recurrence. The patient was then put upon the mixed toxins which were continued daily until a reaction of  $102^{\circ}$ – $103^{\circ}$  was obtained. At the end of two weeks the swelling had disappeared and the patient regained his lost weight. The treatment was kept up for two months, after which he returned home for several weeks and had no treatment. He was readmitted for another course of toxins, lasting about a month. However, in the interval in which the treatment had been discontinued a local recurrence appeared just below the site of the clavicle, in the pectoral region, and also in the neck. The recurrent tumor was soft, almost semi-fluctuating and grew with great rapidity. Although the toxins were resumed and the patient was treated with radium by Doctor Abbe, nothing was able to check the rapid progress of the disease. Metastases developed in the chest shortly after and proved fatal. The total duration of life from the time the trouble was first noticed was about five months.

In this case I believe a great mistake was made in stopping the toxin treatment too soon.

CASE IV.—The case of Dr. Thomas W. Huntington, of San Francisco, Cal., although published in full in my earlier paper, is worthy of special note here, inasmuch as the patient was still in good health when last traced, seven years later. A brief history is as follows: Periosteal, spindle-celled sarcoma of the right clavicle, operated upon on September 8, 1908. Immediately after the operation Doctor Huntington wrote me inquiring as to the advisability of using the mixed toxins as a prophylactic against recurrence, and I replied that I would strongly advise their use. The treatment was begun two weeks after the operation and continued for a period of five months. When last seen by Doctor Huntington in 1915 the patient was still in good health, seven years later. (This case was one of periosteal sarcoma (spindle-celled).)

CASE V.—*Round-celled inoperable periosteal sarcoma of clavicle and scapula becoming operable under treatment.* The history of the case as contained in a personal letter received from Doctor Freeman is



as follows: H. L. S., male, twenty-three years of age. First seen by Doctor Freeman July 17, 1908. The patient had sustained a fracture of the scapula and clavicle eighteen months before; enlarged glands had appeared above the clavicle three months before. One month before he came under Doctor Freeman's care he had another injury, falling upon his back. Shortly afterward a rapidly growing tumor appeared over the right clavicular region. At the time of Doctor Freeman's examination there was a large tumor, involving the upper scapular and clavicular region and extending nearly to the spine; there also was a glandular tumor in the neck, as large as a fist, and another of equal size in the deltoid region. The glands of the left side of the neck were also enlarged and had been enlarged for four weeks; the patient had lost 14 pounds in weight. A specimen of the tumor was removed for microscopical examination and pronounced large round-celled sarcoma with some spindle-cells. The case was regarded as entirely inoperable, even as regards an interscapulo-thoracic amputation. The patient was therefore put upon the mixed toxins of erysipelas and bacillus prodigiosus combined with X-rays. On September 1st, or six weeks later, marked improvement had occurred; the tumor had decreased to half its original size and was much softer. Soon after the patient returned to his home in Oklahoma. Shortly after he had a severe hemorrhage and an interscapulo-thoracic amputation was performed.

Doctor Freeman has kindly written me from time to time, giving the after-history of the case. In his latest letter he stated that the patient was well in 1918, ten years after the treatment.

The only case in my series which was operable at the time of observation, but in which it was decided to try radium instead of operation, is as follows:

CASE VI.—S. L., female, aged twelve years. Family history negative. No trauma.

Patient was admitted to the Memorial Hospital in August, 1919, with a history of, one month ago, having first noticed a small nodule, the size of a marble, in the sternal portion of the right clavicle, which grew very rapidly until it had reached the size of a small hen's egg. Physical examination at this time showed a smooth, rounded swelling of the right clavicle, symmetrical in outline, moderately firm in consistence, about 2 inches by 1½ inches in diameter. The skin was normal in color, not adherent, and there was no marked dilatation of superficial veins. An X-ray picture taken on August 7, 1919, showed the inner third of the clavicle involved by a rarefying process extending outward from its inner end; space between end of bone and sternum is abnormally wide; suggests beginning in clavicle; chest negative.

Although in the opinions of the surgical staff the case was clearly operable, it was decided to try the effect of radium alone with no other treatment. Accordingly, the radium treatment was begun on August 10, 1919, and given as follows by Dr. Douglas Quick:

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August 8, 1919: Radium pack, 9279 mc. hours at 6 cm. distance over the clavicle.

August 14, 1919: Bare tubes containing 17 mc. of radium emanation were inserted.

August 29, 1919: A lead tray, 8000 mc. hours, at 5 cm. distance over the tumor.

October 4, 1919: Radium pack, 10,087 mc. hours at 6 cm. distance over the tumor.

November 16, 1919: Lead tray, 3000 mc. hours, at 3 cm. distance over the tumor.

In addition she received seven X-ray treatments over the anterior chest in November, 1919.

On August 20, 1919, the patient was discharged from the hospital with a decrease in the size of the tumor. Examination on September 2d showed improvement.

An X-ray picture taken on October 7, 1919, showed very little change in the condition of the clavicle. Physical examination November 7, 1919, showed the patient to be improving slowly. An X-ray examination was made on the following day, a report of which is as follows: "X-ray of chest reveals numerous well-marked metastases in lungs. Process in clavicle remains unchanged." She was readmitted to the hospital on November 11, 1919, at which time examination showed no growth in the clavicle tumor, but examination of the chest revealed metastatic nodules. Her general condition was not so good; she was anæmic and had lost considerable in weight. She tired very easily and had occasional pain in the chest.

In spite of X-ray treatments over the chest the patient's general condition rapidly deteriorated and she died on January 20, 1920.

The entire duration of the disease in this case, from the time the tumor was first noticed, was a little over six months; and from the time the treatment was started five months. The very rapid generalization of the disease points to a high degree of malignancy of the tumor. No exploratory operation was made and hence we do not know the histological type of the tumor. It was undoubtedly a periosteal, probably round-celled. Whether the patient could have been saved had the clavicle been removed by total excision, followed by prophylactic treatment with the mixed toxins and radium, it is impossible to state. However, from the results that have been obtained in the other cases already reported, I believe that the chances of a cure would have been greater had such method of treatment been employed. While we have no evidence to show that the very rapid generalization of the disease in the lungs following so closely the introduction of bare tubes of radium in the clavicular tumor was due to the treatment there is a possibility that the introduction of these tubes and the rapid breaking down of the tumor cells may have favored the development of metastases. We have, however, used bare tubes in so

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many other cases in precisely the same way without any apparent influence in the development of metastases, that it is fair to state that it may have been only a coincidence in this case.

This, as far as I know, is the only case in which radium has been used in an easily operable case in this country.

However, a case of periosteal sarcoma of the clavicle, treated with radium alone, was briefly reported by Pinch, of the Radium Institute, of London, about three years ago, and a personal communication from Doctor Pinch received a few weeks ago, contains the following data:

Female, aged sixty-two, was sent to the Institute in June, 1913, for the treatment of a large, rapidly growing periosteal sarcoma of the right clavicle, which had been present for four months. An attempt at its removal had been made in May, but the surgeon found this could only be done if Berger's operation were performed, and patient would not consent to this procedure. The growth formed a prominent tumor, filling up the right supraclavicular fossa and measuring 10.5 x 6 x 2 cm.; it was very firmly fixed to the clavicle. Microscopical examination of portions removed showed it to be a round-celled sarcoma.

A 100 mgr. tube screened with 1 mm. of silver was buried in the tumor for twenty-four hours. The growth steadily shrank, and by the end of July no trace of it remained.

The patient was examined in January, 1918. There had been no recurrence, and all movements of the right arm could be performed fully and freely. Examination February, 1920, showed the patient perfectly well with no recurrence.

While this case in a measure offsets the distressing result obtained in the case I have just reported from the Memorial Hospital, it does not, in my opinion, furnish sufficient evidence to justify one, at the present moment, in substituting radium treatment for surgical operation in an easily operable case of sarcoma of the clavicle.

The results of excision thus far reported enable one to state definitely that the functional result following total excision is so good and the deformity so slight, that one is not warranted in taking much additional risk in attempting to save the bone. Our own case observed at the Memorial Hospital shows the great danger of general metastases developing while waiting to observe the local effect of the radium-ray treatment upon the clavicle.

We have had two border-line cases, in which the possibility of removing the clavicle was doubtful, and we decided to give the patients the combined toxin and radium treatment. In both of these cases large doses of radium, massive doses externally, and bare tubes inserted by means of a hollow needle in the tumor itself. In addition the patients were kept for long periods under large doses of the mixed toxins. In both these cases the improvement following the treatment proved only temporary and metastases developed within six months, ending in death.

CASE VII.—B. F., male, aged forty-nine years, referred to me on August 5, 1918, by Dr. F. H. Albee, of New York, with the following history: Eight weeks ago, while attempting to raise a window, felt sudden, sharp pain in the right shoulder, which ceased on stopping

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motion and recurred on active motion of the arm. The following day he noticed a swelling over the right clavicle. An X-ray picture was taken, which showed a fracture. Arm and shoulder immobilized. Another X-ray picture was taken four weeks later, on July 1st—inconclusive. Wassermann reaction negative. July 20th, exploratory operation by Doctor Albee. Microscopical examination of specimen removed showed large round-celled sarcoma. The report reads as follows:

Gross section is a thin section of bone with hemorrhagic streaks and on one side are pinkish-white, semi-soft, irregular tabs of tissue. Microscopically, the entire picture is of sheets of rather polyhedral or large round cells staining darkly and frequently dividing. These sheets are held in a fibrous stroma and in an alveolar pattern, although frequently overrunning these trabeculae or capsules as the case may be. The picture is typical of malignancy.

Physical examination at the time the patient came to me showed a firm tumor occupying one-half of the right clavicle, beginning at the sternoclavicular articulation and extending  $3\frac{1}{2}$  inches outward. Yielding on pressure shows a pathological fracture.

The patient grew rapidly worse, and in February, 1919, his condition was hopeless.

CASE VIII.—C. A., male, fifty-seven years old, referred to me by Dr. Geo. S. King, of Bayshore, L. I., on December 26, 1918, with the following history: Patient always in good health until September, 1917, when he strained his right shoulder while cranking a car. Shortly afterward noticed pain in his neck and a swelling in the sternoclavicular articulation on the right side. The pain and tenderness decreased somewhat and there was little change for nearly a year. An X-ray picture taken in December, 1918, showed some destruction of bone at the inner end of the right clavicle. A month ago the swelling began to increase more rapidly in size after slight exertion. X-ray pictures taken then showed an extension in the destructive process of the bone, with some crepitation. Wassermann reaction negative. Patient has been unable to raise his arm to a horizontal position for the past three weeks. Physical examination December 26, 1918, showed a swelling occupying the inner two-thirds of the right clavicle, extending to, and involving, the sternocleidoclavicular articulation. The tumor measured horizontally 5 inches and vertically 4 inches; it was firm, almost bony, in consistence and very tender on pressure, particularly over the central portion, and extended up to the cervical region several inches above the normal clavicular line. Just above the upper margin is a small, movable cervical gland, one-third inch in diameter. There is slight dilatation of superficial veins. Patient had lost 15 pounds in weight during the past year. After consultation with Doctor Downes and other members of the staff, the condition was believed inoperable, and it was decided to use the combined toxin and radium-ray treatment.

On December 31, 1918, bare tubes containing 3986 mc. hours of radium emanations were introduced into the clavicle; and on January 1,

1919, a radium pack of 9864 mc. hours at 10 cm. distance was placed over the right clavicle for 9 hours.

At first there was marked diminution in size of the tumor and great improvement in the patient's ability to use the arm. After about two months, however, the swelling began to increase in size and the patient's general condition to deteriorate. In spite of continued treatment, pushing the radium to the point it was thought safe, it was impossible to gain control of the disease. The patient continued to decline and died on March 27, 1919.

The following case, like my own second case of total excision, shows the extreme malignancy of some cases of sarcoma of the clavicle. The history of this case was kindly furnished me by Dr. Walter B. James, who showed me the X-ray pictures and consulted me as regards treatment:

CASE IX.—A. L., male, forty-eight years of age; always strong and well until September, 1913, when he fell, while playing golf, striking upon the shoulder and injuring his left clavicle, but not apparently sustaining any fracture. The arm was put in a splint for several weeks. A short time after the injury, a swelling developed in the region of the clavicle, which was first believed to be tuberculous. All tests for tubercular and specific disease proved negative. An X-ray picture taken in December, 1913, showed marked destruction of the inner end of the clavicle with apparently some involvement of the mediastinal glands. Rapid decline in general health. The patient's physician, Dr. E. R. Baldwin, of Saranac Lake, on February 26, 1914, said: "The patient is now dying of slow collapse with every evidence of a dissemination of sarcoma." Death occurred two days later, making the entire course of the disease from the time of the injury to death, less than five months.

In the following case the disease ran nearly as rapid a course as in the preceding:

CASE X.—A. T. B., forty-seven years of age, was referred to my service at the Memorial Hospital, on April 3, 1917, with a history of having had an attack of influenza followed by pleurisy; was in bed for ten days. At the end of this time he first noticed symptoms in the right shoulder and outer part of clavicle, tenderness, swelling and some limitation of motion; was treated for rheumatism for a number of weeks. In the meantime the tumor of the clavicle rapidly increased in size. On April 3, 1917, the radiograph showed almost complete destruction of the right half of the clavicle, with extensive involvement of the roots of both lungs by metastatic nodules. He was treated for a brief period of two to three weeks with the mixed toxins of erysipelas and bacillus prodigiosus with no appreciable effect. In view of the marked generalization of the disease, it was thought unwise to continue the treatment. He died a few weeks later, the entire course of the disease being less than six months.

CASE XI.—H. K., male, aged thirty-one years. In May, 1897, car-



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ried heavy piece of steel on right shoulder; one month later noticed lump directly over clavicle at the point where the steel rested. July, 1897, removal of gland below clavicle by Doctor Mayer, of Buffalo. Three weeks later a nodule appeared in the axilla. When seen by me in February, 1898, the patient's neck and shoulder were occupied by an enormous tumor extending to sternum in front and nearly to the vertical column behind. No treatment advised. Prognosis: Six weeks to two months' life.

CASE XII.—Mrs. L. C., adult, was referred to me on July 19, 1912, with the following history: In June, 1911, she had had a strain in the region of the right clavicle. Two months later a small swelling was noticed in the sternal end of the clavicle, which gradually increased in size. She was treated for rheumatism for six months. The clavicle was excised by Doctor Trout, of the Jefferson Surgical Hospital, Roanoke, Va., in May, 1912, and a pathological examination showed it to be an angio-sarcoma involving the sternal end. As much of the surrounding tissue as possible was removed and X-ray treatment given; but in spite of this, a recurrence developed in a few weeks.

Physical examination, in July, 1912, at the time of my first observation, showed an inoperable recurrent mass just above the sterno-clavicular articulation. The patient complained of pain and numbness in the arm. The end-result in this case has not been traced.

CASE XIII.—D. B. A., male, adult. The patient first noticed a swelling in the sternal end of the right clavicle in November, 1909, for which an operation was performed in January, 1910. A second operation was performed in 1911, at which time the glands were removed. In August, 1914, a total excision was made, and in the beginning of the following year, 1915, the patient noticed cedema of the right arm and forearm. He was referred to me by Dr. J. B. Hulett, of Middletown, N. Y., in November, 1915, at which time physical examination showed an inoperable mass above the site of the right clavicle, extending over to the sterno-mastoid insertion and two inches backwards. The mass was firmly fixed and quite inoperable. The patient had lost slightly in weight. I was unable to get a pathological report in this case, but the tumor was undoubtedly a malignant one. It has been impossible to trace the final result.

CASE XIV.—*Round-celled periosteal sarcoma of the left clavicle.* Patient was referred to me by Dr. J. Collins Warren, of Boston. Specimen removed in October, 1903, was pronounced round-celled sarcoma. The tumor almost entirely disappeared under X-ray treatment, but later started to increase in size and was no longer controlled by the X-rays. In October, 1904, the patient was referred to me by Doctor Warren. At this time a pear-shaped tumor occupied the sternal portion of the left clavicle; there was glandular involvement above and below the clavicle and slight enlargement of left arm. From October 6 to November 26 the mixed toxins were given in conjunction with X-ray treatment, with slight temporary improvement only.

CASE XV.—H. B., male, aged twenty-two years. No single trauma, but in habit of carrying iron pipes upon left shoulder. Pain in shoulder



more than a year before tumor appeared. Small mass in outer portion of left clavicle noticed in January, 1910. Removed by Doctor Stewart, Newport, R. I., in March. Microscopical examination showed tumor to be round-celled sarcoma, periosteal. Recurrence three weeks later; rapid growth. Patient seen by me in September 15; toxins started immediately and continued to October 20, 1910, with little or no effect in controlling growth.

Patient died three months later.

CASE XVI.—E. S., male, aged twenty-one years. Patient broke his left clavicle in May, 1893; one year afterward a swelling appeared at the site of the fracture and grew rapidly. Partial removal of clavicle. recurrence soon after, involving scapula. Mixed toxins tried for a short period, without success. Excision of remaining portion of clavicle; entire scapula and upper extremity removed by Dr. W. W. Keen, of Philadelphia. Death eight months later from recurrence.

CASE XVII.—G. M., male, nineteen years of age. Tumor had existed for two years; first treated for rheumatism. No trauma. Came to New York Hospital in April, 1909, where Dr. Frank Hartley did a total excision. Microscopic examination made by Doctor Elsner, who reported the disease to be spindle-celled sarcoma. Three months later, local recurrence above and below the former site of the former clavicle. Patient referred to me in September, 1909, with numerous recurrent masses over the whole upper portion of the right chest. The mixed toxins were given, and while at first there was considerable decrease in the size of the various nodules and increased mobility, the improvement was temporary only and the toxins failed to control the further growths of the tumors. Patient died a few months later.

CASE XVIII.—*Periosteal sarcoma of clavicle. Partial resection. Death one year, in Case LXI, tables.*

Three cases reported by Dr. H. B. Delatour, which, by an oversight, were not included in my former paper, are worthy of note.

CASE I.—A. H., male, aged thirty-seven years; operated upon July 21, 1896, at the Long Island College Hospital. Antecedent trauma, May, 1894; injured left clavicle while wrestling; three months later tumor appeared at about the middle third of the bone. This grew slowly until November, 1895, when it suddenly ruptured while patient was walking on the street; hemorrhage profuse. The following day the tumor was removed. Hemorrhage during operation very severe, controlled with difficulty. Four months later, local recurrence; second operation in July, 1896; the tumor was the size of a hen's egg; veins dilated; no enlarged glands. Patient made a good recovery. The report states that 33 months after operation there was no evidence of a return. According to a personal communication received, the patient was alive five years later, since which time he was lost track of. The patient was able to perform the same type of work (porter in a rubber factory) as before operation, without any inconvenience. Pathological diagnosis: Type of tumor not stated, apparently of central origin.

CASE II.—Female, aged twenty years; no trauma; history of swelling

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and neuralgic pain in the right arm for two months. There was also a tumor in the posterior surface of the clavicle. Pathological diagnosis: Osteo-sarcoma (Dr. Van Cott). Patient lost sight of shortly after operation.

CASE III.—Sarcoma of the clavicle, involving sternum and first rib. Male, aged fifty-five years. History of a tumor of two months' duration which appeared shortly after a local injury, three months before; very rapid growth. Operation August 14, 1897. Complete extirpation of clavicle; division of rib and sternum from the left sternoclavicular articulation to the second chondrosternal articulation. Removal of a triangular portion of the sternum and inner portion of the first rib; several enlarged glands were removed from the anterior mediastinum. Patient discharged six weeks later in good condition. On December 7, 1897, the patient was admitted to the same hospital suffering from a fracture of the base of the skull, from which he died. No evidence of a return of the growth.

Case reported by Dr. George Tully Vaughan (*Med. News*, January 8, 1898).—W. S., male, twenty-eight years of age. Symptoms of seven months' duration before operation; considerable pain; tumor occupied the inner two-thirds of the clavicle. Operation at the German Hospital, Philadelphia, October 22, 1895; ether anæsthesia. The entire right clavicle with tumor removed; troublesome hemorrhage, requiring 20 ligatures. Primary wound healing, except at two points. Discharged 41 days after operation. Microscopical examination showed the tumor to be a mixed-celled (round and spindle) sarcoma. (Dr. Alfred Stengel.) One year after operation absolutely no deformity, except the absence of the clavicular prominence; patient is performing his work as fireman on a steamboat, without any inconvenience from the loss of the clavicle. Arm is free from pain and strong as ever.

A recent communication from Doctor Vaughan, dated April 16, 1920, states that the patient was perfectly well when last heard from, eighteen years after removal of the clavicle. At that time he had what his physician in the West believed to be a mild form of tuberculosis of the lung; he did not think it was metastatic or a recurrence.

*Case Recently Reported and Not Included in Previous Collections.*—Dodd (*Ohio State Med. Jour.*, March, 1918) reports a recent case of sarcoma of the clavicle: Female, aged thirty-five years, first noticed a swelling in the right clavicle in March, 1916. This gradually increased in size until October, 1916, when it began to grow more rapidly. In February, 1917, it had reached the size of a grapefruit. The patient was seven months' pregnant. Operation was performed in February, 1917; there was some sloughing of the flap; on the fifth day the patient developed septicæmia and died on the fourteenth day after operation. Microscopical examination showed the tumor tissue rich in cells: osteo-sarcoma with some mucoid in the cellular substance, round and spindle-celled; no giant cells were found; tumor of periosteal origin.

In view of the great size of the tumor and the extent of the involvement, I believe this case should have been considered an inoperable one.

*Myeloma of the Clavicle.*—Dr. James M. Hitzrot, before the New York Surgical Society (Transactions, ANNALS OF SURGERY, 1918, vol. lxxviii, p. 92), reported a case of myeloma of the clavicle in a male, forty years of age. The patient fractured his right clavicle near the sternal end in January, 1917. Shortly after noticed a small swelling at this site, which slowly increased in size. He was admitted to the New York Hospital on February 20, 1918; Wassermann test negative. Total excision of the clavicle was performed by Doctor Hitzrot. A microscopical examination of the tumor by Doctor Ewing showed it to be a myeloma. Five X-ray treatments were given in the region of the clavicle after operation as a prophylactic.

*Trauma.*—In my own series of cases of sarcoma of the clavicle there is a history of antecedent local injury in such a large proportion of the cases that it is very difficult not to believe that trauma is an important etiological factor in the disease. The nature of the injury varies between a strain and a blow: Case I, Severe strain, tumor developing in three weeks. Case IX, Fall; local injury to the clavicle; tumor in three weeks. Case VIII, Shortly after a severe strain of the shoulder from cranking a car. Case VI, no trauma. Case III, Is a good example of acute traumatic malignancy, inasmuch as the tumor developed two weeks after striking the clavicle upon the sharp corner of a wooden box. Case VII, Severe strain, tumor two months afterward. Case VII, Carrying a heavy steel bar directly over the clavicle, some distance. One month later a tumor developed at the exact site. Case XVIII, Severe strain from swinging off a trolley car while in motion; tumor one month later. Case XVI, Tumor at site of a fracture which had occurred one year before. Case V, Injury to shoulder (fracturing clavicle and scapula) two months before. Case XI, Severe bruising of shoulder while carrying steel bar, due to helper's dropping the other end. Tumor two to three weeks later, at the site of the injury. Case II, Plank fell over and struck patient on left clavicle six to seven years previously. Case X, No history of trauma, but tumor developed ten days after an attack of acute influenza.

Johansson states that the great majority of these tumors are sarcomata. A very rare but interesting group of bone tumors, from a pathologico-anatomical point of view, are the so-called endotheliomata. Howard and Crile, in 1905, had collected 23 such cases, and Johansson's statistic includes two additional cases probably belonging to this group.

The so-called strumametastases form another very rare type of bone tumors. Four of these are known to have occurred in the clavicle and were treated by extirpation. Histologically, they present the characteristics of adenoma. The primary tumor may be a carcinoma, Johansson states, or more rarely, also an adenoma. In a few instances no struma at all could be found; the thyroid gland was atrophic. I do not believe there has been reported a single undoubted case of primary carcinoma of the clavicle—in some cases the primary tumor was not.

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Johansson reports the following three cases of malignant disease of the clavicle, two of which were operated upon at the Sabbatsberg Hospital:

CASE I.—A. J., female, aged sixty-eight years, 1903. In March, 1901, patient fell and sustained a supracondylar fracture of the left humerus. In February of the following year she again fell and fractured the arm immediately above the old fracture. X-rays at the time had shown no suspicion of a tumor. Good union of fracture within normal time. Good apposition and function of arm. Toward the end of the same year, patient noticed swelling at the site of the fracture, accompanied by some pain. Re-admitted to the hospital on February 5, 1903. Examination at this time showed a large tumor occupying the lower half of the left humerus. Diagnosis: *Osteosarcoma*. Exarticulation of humerus. Primary union. Two weeks later, swelling of right shoulder. Examination shows a tumor, nearly half the size of a hen's egg, at the acromial end of the right clavicle. Microscopical examination: Spindle-celled sarcoma, small cells. Patient discharged from hospital March 28, 1903. Death five years later, March 2, 1908, of catarrhal enteritis. The report states that she was able to use her right arm perfectly well, and that there was no sign of a recurrence. No autopsy.

CASE II.—U. F., female, sixty-seven years of age; 1911. Patient ascribes trouble to trauma, a friend having repeatedly struck her with a board—in fun. Examination at time of admission, July 12, 1911: Firm tumor palpable over outer third of right clavicle, size of a hen's egg, attached to the bone. Diagnosis: peripheral sarcoma. July 15, extirpation of clavicle; no enlarged glands. Microscopical examination, spindle-celled sarcoma. About five months after operation, marked loss of weight, considerable coughing and pain in chest. Death of cachexia January, 1912.

CASE III.—O. B. (Military hospital, Seraphim), male, fifty-eight years of age, 1888. Slight injury to clavicle a year ago; sensitiveness at site of injury three weeks later, swelling within one month. This grew slowly at first, then increased more rapidly in size until at time of operation, beginning of August, it had reached the size of a fist, attached to the bone; no enlarged glands. Total extirpation of clavicle plus upper right points of sternum; discharged November 19, 1888. Not traced. Microscopical examination: *Chondrosarcoma*.

Johansson gives a brief résumé of 32 cases of tumor of the clavicle previously reported but not contained in any of the lists of collected cases so far published (see table). He also gives the references of six additional cases, stating that the respective journals were not available.

Only 3 of a series of 62 cases of bone sarcoma observed at the Sabbatsberg Hospital from 1879 to 1911 were sarcomas of the clavicle.

*Age and Sex.*—Of 84 cases regarding which statements as to age and sex were found, 51 were males, 33 females, or about 60 per cent. of males.

Sarcoma of the clavicle is most frequently observed at the age of puberty, the eleventh to twentieth year of life. Nearly 60 per cent. of the cases occur in patients below the thirtieth year.

*Localization.*—Statistics show the cases of malignant tumor of the clavicle to be about evenly divided between the right and the left side. Thirty occurred in the sternal end of the clavicle; 18 in the acromial end; 10 in the middle portion, and 4 involved the entire clavicle.

Three cases of metastatic sarcoma of the clavicle are on record, namely, Besson's case, in which nine years before a resection of the upper jaw had been done; Johansson's case here reported, in which the primary



tumor originated in the humerus, and Jones' case, in which the original tumor started in the tibia, causing a fracture.

The desire to know whether we are dealing with a comparatively benign or a highly malignant tumor in a given case has become more pronounced since the conservative treatment of bone sarcomas, as first proposed by Mikulicz, has been gaining ground. That histological examinations are not always reliable in this respect no doubt most surgeons have had occasion to observe.

Johansson states that Ribbert and Borst have greatly advanced the study of the histology of bone sarcoma by their recent contributions to the subject. The former considers all sarcomas of the bones as originating in the spongiosa of the diaphyses, which theory seems to find support in the great significance of the X-rays as regards determining the degree of malignity of the tumors.

Borchard, on basis of Borst's investigations, distinguishes between a central group—from which he excludes and forms into a separate group the so-called myeloid tumors—on the one hand, and an inner or outer periosteal group—according to whether they start from the inner or outer layer of periosteum—on the other hand. In the former case they are surrounded by a bone shell.

Of the 30 cases of sarcoma of the clavicle compiled by Johansson, 9 were resections, 15 total extirpations. Of the remaining 6 cases of malignant tumor of the clavicle, 5 were treated by total extirpation, one by resection.

*Mortality.*—Delatour gives the operative mortality as 18 per cent. (40 cases); Caddy, 16 per cent. (42 cases); Johansson's collection of 31 cases operated upon (25 sarcomas) shows no mortality. The mortality on basis of 87 cases would, therefore, be 11.5 per cent. Johansson believes, however, that this percentage is too high an estimate, inasmuch as at least 3 of the cases should be excluded, namely, v. Langenbeck's and Heath's cases in which death was due to a brain tumor; and Segond's case in which visceral metastases were the cause of death. Deducting these, the above figure would be reduced to 8 per cent. Then also allowance should be made for the fact that a number of these fatal results occurred in pre-antiseptic times.

Accepting the time limit of four years, which is the latest period at which recurrences have been observed, Johansson states that only 4 cases were found to have remained free from recurrence, one of these (Mott's famous case) fifty-five years, another ten years, and two others upwards of five years. Three of these were central sarcomas. To these should be added the Vaughan case well eighteen years, which makes 5 cases cured by total excision in a series of 90 cases.

*Functional Result.*—Experience has shown that the functional value of the arm after extirpation of the clavicle is but little impaired in most cases. In 21 of Johansson's 36 collected cases mention is made of the



FIG. 9.—Case X.

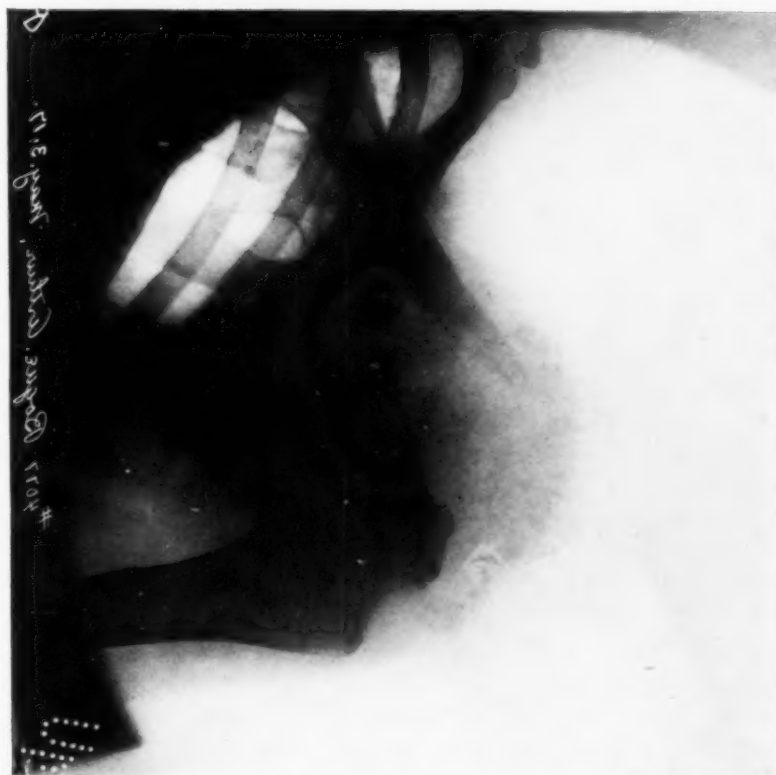


FIG. 10.—Case X. Three months later.





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functional result, and of 20 this is stated to have been good or very good. The deformity, also, is generally given as slight.

Kalus made a careful study of the literature up to 1912, which showed a total of 98 cases, 92 of which were stated to be sarcoma. He reports two cases operated upon at the Greifswald Clinic, one an osteosarcoma, the other an adenocarcinoma, which was considered to be metastatic, although the seat of the primary tumor could not be determined at the time of the operation.

In the first case (osteosarcoma of right clavicle) resection of a piece 7 cm. long was done, with Gigli's saw and bone transplantation from tibia added. The patient, a woman forty-seven years of age, was operated upon on September 18, 1910, and discharged on the 24th of October. Six months later she returned complaining of severe pain in the right clavicle. Examination showed the presence of pseudoarthroses at the junction of clavicle and transplanted bone. The pain is apparently due to the wire sutures. A second operation is done and the patient is dismissed on the 10th of April, 1911, with free use of the arm, although the pseudoarthrosis persisted. There is no deformity at the site of operation. A report obtained from the local physician nine months after the second operation, states that the patient complains of pain at the site of operation and inability to use the arm for any length of time. There are no enlarged glands; no signs of a recurrence; general condition good.

In view of the splendid results obtained after resection or total extirpation of the clavicle, without bone transplantation, Kalus believes this an entirely unnecessary procedure.

CASE II.—Male, aged sixty-two years. In August, 1911, laid a heavy beam upon his left shoulder in order to lift a wagon; pain and swelling followed. Was treated by physician with salve. In September was able to resume his work as mill worker. Two weeks later return of swelling, little pain, but limitation of motion of left arm. Later some loss of weight. Admission to the Greifswald Clinic November 1, 1911; operation on the 7th. Removal of tumor which was the size of a man's fist; considered metastatic; primary tumor not found. Uninterrupted wound healing. Discharged December 16, 1911. Head of humerus prominent on account of absence of clavicle; active abduction in shoulder-joint; active elevation anteriorly greatly limited; rotation around axis of brachium but little interfered with. The patient was reported to have died of cachexia in the middle of September, 1912 (opening of œsophagus into the stomach). Autopsy had shown a primary carcinoma of the cardia with numerous metastatic nodules in the liver.

Kalus believes this to be the first reported case of carcinoma of the clavicle which was recognized as metastatic at the time of the operation, the seat of the primary tumor (cardia) being revealed later at autopsy. I have observed two cases of secondary carcinoma of clavicle but did not operate upon either. Aimes and Delord (*Progrès Medical*, Paris, April 24, 1920, xxxv, No. 17, p. 81) found 98 cases of sarcoma in 126 cases of tumors of the clavicle.

In view of the case already referred to, that of Pinch of the Radium Institute of London, complete disappearance and apparent cure of a sarcoma of the clavicle by a single treatment with radium alone, the patient remaining well for five years—a very important question naturally arises, *i.e.*, shall we

TABLE OF REPORTED CASES OF SARCOMA OF CLAVICLE.

No.	Reporter	Date	Reference	Sex	Age	Side	Site	Duration	Description	Operation	Type	Result	Final report	Remarks
1	Mott	1829	Amer. Jour. Med. Sci., 1828, iii, 100	M	19	L	Beneath and adherent to clavicle	.....	Size of two fists	.....	Osteo. with ulceration	Recovery	Well 50 years	
2	Warren	(1832)	Surg. Obs. of Tumors, p. 405	M	24	R	Inner end	.....	.....	Total excision	Pulsating	.....	.....	Died of pleurisy 4 weeks after Trauma
3	Travers	1837	Med. and Surg. Trans., p. 135	M	10	L	Inner end	1 year	.....	Total excision	Osteo.	Recovery	Well 6 mos.	
4	Liston	1844	Lancet, p. 361	M	..	..	.....	.....	.....	Total excision	Soft	Recovery	Recurred in 3-4 months	
5	Chauvet	1849	Gaz. Med. de Paris	F	18	L	Outer	9 months	Size of fist	Resection of external four-fifths	.....	Recovery	.....	
6	Gallardon	1847	Gaz. des Hop.	F	45	..	Middle, sternum, 1st rib	.....	.....	No operation	Vascular pulsating	.....	.....	Died of broncho-pneumonia
7	Rigaud	1850	Gaz. Med. Strasbourg, A. X., p. 103	F	15	L	Inner	7 years	Size of fist	Resection of inner two-thirds	.....	Recovery	.....	
8	Owens	1854	New Orleans M. and S. J., vol. xi, p. 164	F	35	L	Inner	1 year	Egg	Excision, one-half	Osteo-sarcoma	Recovery	Well on tenth day	Final results not traced
9	Laugenbeck	1855	Deutsch. Klinik	F	11	L	Both ends	.....	.....	.....	Spindle-cell	Died on 6th day	.....	
10	Syme	1857	Ed. Med. J., iii, Pt. I, 192	F	20	..	Outer end	.....	3½ x 4½ cm.	Total excision	Osteo.; myeloid cells; cystic	Recovery	.....	
11	Cooper	1858	Gaz. de Hop.	..	..	L	.....	.....	Size of a hen's egg	Total resection	.....	Recovery	Recurrence; died in 4 yrs.	Died of bronchitis
12	Esmärck	1859	Nissen. Diss. de resect. Kilian	M	33	R	.....	.....	.....	.....	Myeloid	.....	.....	Fracture
13	Nélaton	1860	Thesis de Paris	F	46	R	Inner and sternum	2 years	Size of a lemon	Resection of inner third	Fibrous elements	.....	.....	
14	Gosselin	1861	Bull. Soc. de Chir., 2d series, ii	M	37	R	Inner third	.....	Size of a citron	.....	Spindle-cell	.....	.....	
15	Peau	1861	Gaz. de Hop., p. 419	M	37	..	.....	.....	.....	.....	Fibrous and fibroplastic	.....	.....	
16	Nélaton	1863	Bull. Soc. Anat., 2d series	F	30	..	Middle	.....	.....	.....	Myeloid	.....	.....	
17	Richet	1864	Dict. de Med. et de Chir. Pratiq., viii	M	65	R	Inner third	2 years	.....	Resection of inner third	.....	.....	Recurred 18 months after in scar	
18	Paquet	1867	Bull. de la Soc. Anat., p. 634	M	21	R	Inner end sternum, 1st rib	6 months	12 x 8 cm.	No operation	Embryonic and myeloid	.....	.....	Died
19	Delore	1868	Gaz. Med. de Lyon, iii, 93	..	..	..	Inner end	.....	.....	.....	Medullary carcinoma	Recovery	.....	Doubtful
20	Morin	1868	Ibid.	Child	..	..	.....	.....	.....	.....	Carcinoma	.....	.....	Doubtful
21	Meyer	1868	Gaz. Med. de Lyon, No. 8, p. 93	Child	..	..	.....	.....	.....	.....	.....	.....	.....	Doubtful

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22	Sean and Eve	1869	Chicago Med. Exam., x. 653	M 12	L	End	14 months	.....	Total excision Vein injured at operation	.....	.....	.....	Cervical glands enlarged; died from exhaus- tion
23	Cooley	1870	St. Louis Med. and Surg. Jour., p. 62	M 30	L	Middle	.....	.....	.....	.....	.....	.....	.....
24	Britton	1870	Brit. Med. Jour., i, 518	M 35	L	Outer end	2 years	Size of an orange	Resection of all except acrom. end	.....	.....	.....	.....
25	Eve	1871	Nashville Jour. Med. and Surg., i, 68	M 13	L	.....	7 months	Size of an ovary	.....	Enchondroma (red, flesh-like)	Died	.....	Doubtful spontaneous fracture
26	Richet and Demondre	1873	Paris Thesis	F 51	L	Outer end	3 months	Size of an orange	Resection of outer end	.....	Healed in 15 days	.....	.....
27	Tausini	1883	Gaz. degli Ospitali, Milano, No. 39, p. 306	F 30	..	Inner end	.....	Size of an egg	.....	Myxœdema	.....	.....	.....
28	Deprès	1885	Bull. de Soc. de Chir., pp. 143-226	F 14	R	Outer end	.....	Size of an orange	.....	Central	In hospital 31 days	.....	.....
29	Segond	1885	Ibid.	M 66	..	.....	.....	.....	.....	.....	Died on 8th day of vis- ceral in- volvement	.....	.....
30	Pollecaillon	1885	Bull. de Soc. de Chir., p. 146	M 16	R	Outer end	18 months	Size of fist	Resection of external thirds	.....	.....	Well 3 mos. died of sar- coma of femur	.....
31	Kronlein and Kitter	1885	Inaug. Diss. Zurich	F 17	L	Central part	.....	.....	Total resec- tion	Periosteal; round cell	.....	Prompt re- currence; well 10 yrs.	.....
32	Wheeler	1885	Trans. Acad. Med. of Ireland	M 43	L	.....	.....	.....	.....	.....	.....	.....	Slight blow; pathosis; imp. well 10 years later
33	Sloan	1887	Am. Jour. Med. Sci., p. 485	M 14	R	.....	.....	.....	.....	Carcinoma (?)	.....	Recurred 6 mos. after	Doubtful
34	Heath	1888	Lancet, i, 721	M 30	L	Outer end	3 years, 10 months	.....	Excision	Spindle and round cell	Seven days after oper- ation de- veloped br. symptoms	Died on 11th day	.....
35	Chiene	1888	Lancet, i	F 15	..	.....	.....	.....	Excision	Myelogenous	.....	Soon re- curred	.....
36	Wauscher	1889	Hosp. Tiden de Kop- enhagen, Feb., i, 310	M 18	..	.....	.....	Size of an egg	Resection of inner two- thirds	.....	Died of sep- sis	.....	.....
37	Rouse	1889	Lancet, i, 575	M 29	..	Inner end	6 weeks	.....	.....	.....	.....	.....	.....
38	Jeset	1889	Lancet, p. 1077	F 18	R	Inner end	.....	.....	.....	.....	Healed in 2 months	.....	.....
39	Harlam	1863	Brit. Med. Jour., p. 848	M 31	..	.....	.....	.....	.....	Periosteal; round-cell pulsating coma	Primary union	Well 5 mos.	.....
40	Garre-Norkus	1893	Beitrag. zur klin. Chit., ii	F 31	R	Outer end	1 year	2 inches long	Total excision	Myeloid; Osteosar-	Immediate recovery	Well 5 years	.....
41	Curtis-Norkus	1893	Am. Jour. Med. Sci., xxiv. 350	F 20	L	.....	5 years	.....	.....	.....	.....	.....	Probably syph- ilitic

TABLE OF REPORTED CASES OF SARCOMA OF CLAVICLE—Continued.

No.	Reporter	Date	Reference	Sex	Age	Site	Duration	Description	Operation	Type	Result	Final report	Remarks	
42	Legueu	1895	Bull. Soc. Anat.	F	24	..	3 months	Nut	Total excision	.....	.....	.....	Pulmonary tuberculosis	
43	Courtin	1897	Gas. Hbd. des. Sc. Med. de Bordeaux, xviii	F	11	L Middle and inner end	.....	.....	.....	Osteo.	.....	Lived 1 mo.	.....	
44	Verstraete (Operator Duret)	1898	Jour. de Sc. Med. de Lille, i	M	46	R Middle and inner end, 1st and 2d ribs	7 months	Size of an orange	Total resection	Subperiosteal; encapsulated	Recovery	Traced one month	.....	
45	Besson (Operator Duret)	1898	Ibid. Page 466	M	39	R External end	7 months	Size of an egg	Total excision	Myeloid; periosteal Round and spindle myeloid complex	Recovery	Traced only 3 weeks	Operated on 9 years before for sarcoma of superior maxillary	
46	Flament	1898	Ibid., ii	M	10	R External two-thirds	1 month	Size of an egg	Resection of external two-thirds	.....	Recovery	Well 1 month	.....	
47	Bourg	1902	Paris Thesis	M	45	R Middle and inner end	2 years	Size of an orange	Total resection	Osteo.	Recovery	.....	.....	
48	Jonnesco	1903	Bull. et Mem. Soc. de Chir. de Bucarest, vi, 253	..	..	L	.....	.....	Total resection	.....	.....	.....	.....	
49	Degonville	1904	Paris Thesis	M	50	L Middle third	2 years	.....	.....	Myeloid and round-cell	.....	.....	.....	Fracture; multiple fractures of ribs; died before operation; weighed when removed 1000 grams
50	Kryukoff	1904	Russk. Vrach., St. Petersburg, iii, 775	F	12	R	.....	.....	Total resection	Round-cell	.....	.....	.....	Toxins almost immediately after operation
51	Buteanu	1905	Bull. Soc. de Med., et Nat. de Jassey, xix.	..	..	.....	.....	.....	.....	Osteo.	.....	.....	.....	.....
52	Coley	1909	Am. Surg., 1910 (Coley)	M	16	L Middle portion, myelogenous, round-celled	6 weeks	Size of an English walnut	Total resection followed by toxins	Periosteal	Recovery	Well at present, 1910; one year later	.....	Toxins almost immediately after operation
53	Huntington, Thos. W.	1908	Ibid.	M	39	R Outer and middle third	2 years	English walnut in size	Total resection followed by toxins (Coley)	Spindle-celled periosteal	Recovery	Well 2 years	.....	Followed a blow
54	Gilbert Barling, Birmingham, Eng.; personal communication	1889	Unpublished Ibid	M	33	.. Inner half	Several months	.....	Resection total	Spindle-celled	.....	Died on 4th day from suppuration of mediastinum and pleurisy	.....	Fracture through middle of bone

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55	Ibid.	1901	Ibid	P 10	L	Middle and inner portion	.....	.....	Total excision	.....	.....	.....	Recurred 9 months after, in scar; died a few mos. later	
56	Richardson, M. H.; personal communication (Coley)	1908	Ibid	M 34	L	Middle and inner third	4 months	.....	Total excision followed by toxins (Coley)	Small, round-celled	Recovery	Well 2 years and 2 mos.	Plank fell over striking patient on left clavicle then toxins used; temporary; improved only	
57	Hartley, Frank	1909	Ibid	M 19	L	.....	2 years	.....	Total excision	.....	Recovery	Recurred in 3 months in side of chest		
58	Keen, W. W. (Coley)	1898	Ibid	M 21	..	.....	.....	.....	First operation partial; second, interscapular thoracic amputation; toxins	.....	Recovery	Died 8 mos. later, from recurrence		
59	Bodine (Coley)	1906	Ibid	M 8	R	.....	3 months	.....	First, lancing of abscess; second, partial removal of tumor	Periosteal; round-celled	.....	Death in a few months	Received blow Oct., 1905	
60	Warren, J. Collins (Coley)	1902	Ibid	M 46	L	.....	6 months	.....	No operation; toxins; X-ray	Periosteal; round-celled	.....	Died 1 year later	Trauma; dislocation of shoulder	
61	L. L. College Hospital (Coley)	1909	Ibid	M 38	L	Inner third	1 week	.....	Operation Partial removal of Clavicle	Rapid growth	Recurrence in supra-sternal fossa; toxins then given with little benefit	Died in 1 year	Strained shoulder	
62	Stewart (Coley)	1910	Ibid	M 20	L	Outer third	2 months	Tumor size of English walnut, outer end of clavicle	Operation; Dr. Stewart, Newport, R. I., March, 1910 (Excision)	Periosteal; round-celled	Recurrence 3 weeks; very rapid growth	Mixed toxins (Coley) Sept. 15 to Oct. 15, 1910; no effect on very large tumor	No single trauma, but habitually carried iron pipes and heavy material on left shoulder	
63	Coley	1898	Ibid	M 31	R	Outer end	9 months	Tumor of enormous size	General condition very bad; prognosis, few weeks of life	No operation	No treatment		Died	



TABLE OF REPORTED CASES OF SARCOMA OF CLAVICLE—Continued. (Most of the following cases were collected by Johansson)

No.	Reporter	Date	Reference	Sex	Side	Site	Duration	Description	Operation	Type	Result	Final report	Remarks
64	Johansson	1903	Deutsche Zeitschr. f. Chir., 1912	F 68	L	Acromial end secondary to osteo-sarcoma of humerus	Few weeks after extirpation of humerus f. osteo-sarcoma 6 months	Size of half a hen's egg	Extirpation of clavicle	Spindle-celled sarcoma in small cells	Good	Death 5 yrs. later of encephalitis—no sign of recurrence	Fractured humerus twice. Osteo-sarcoma extirpation of humerus
65	Ibid.	1911	Ibid.	F 67	R	Outer third	6 months	Size of a hen's egg, b. a red trauma swelling 1 month later	Extirpation of clavicle	Spindle-celled sarcoma	Fair	Six months later death cachexia	
66	Ibid. (military hospital)	1888	Ibid.	M 58	R	Sternal end	.....	Trauma swelling 1 month later	Total extirpation	Chondro-sarcoma	.....	Not followed up	
67	Smith J. W.	1902	Brit. Med. Jour., 1902, I, p. 720	M 18	L	Outer two-thirds	5 months	Trauma	Total Excision	Chondro-sarcoma	Good	Recurrence 1 year later	Death
68	Barton	1874	Dublin Med. Jour. of Med. Science, 1874, I., p. 92	F 24	L	Below left clavicle near sternal end	Little over a year	Size of coconut	Inoperable	*Medullary cancer	No operation	Death duration of life, 2 years	Autopsy showed metastases of lung and right humerus
69	Jones	1880	Trans. Path. Soc., London, 1880, vol. 32, p. 242	F 45	L	Primary in tibia metastases in parietal bone and clavicle	.....	No trauma	No operation	Sarcoma	.....		
70	Sansom	1884	Lancet, 1884, I, p. 563	M 40	R	Suprascapular fossa extending into axillary cavity	5 months	First noticed swelling of right shoulder and arm, started in middle of clavicle	No operation	Mixed-celled sarcoma periosteal	.....	Death	Autopsy showed metastases in kidney
71	Lunn	1886	Trans. Path. Soc., London, 1886, Vol. xxxviii, p. 287	M 64	R	Right clavicle	2 weeks	Large tumor starting in periosteum	No operation (inoperable)	.....	.....	Death	Autopsy showed nodules in surface of liver
72	Sutton	1890	Lancet, 1890, II, p. 821	F 26	R	Acromial half	.....	.....	Resection of acromial half	Myelogenous	Excellent		Not traced
73	Ollier	1891	Traité des Resections, 1891, Vol. III, p. 895	F 42	..	Sternal end	.....	"Pulsating tumor"	Resection of sternal end	.....	Only fair	Death after 2 years	Nothing stated recurrence

\*Almost certainly sarcoma from description of case.

# SARCOMA OF THE CLAVICLE

74	Caddy	1892	N. Y. Record, 1892, Vol. xliii, p. 586	M 26	R	Sternal end	Trauma 1 year ago	Trauma	Resection of inner two-thirds	Periosteal spindle-celled	Good	6 mos. later no recurrence	Death
75	Gibb	1895	Glasgow Med. Jour., 1895, Vol. xliiv, p. 301	F 16	L	Sternal end	10 months	Large tumor sternal end	Resection of inner third	Spindle-celled	Good	Local recurrence 15 mos. after operation	
76	Delatour	1896	Annals of Surgery, 1903, Vol. xxxvii, p. 301	M 37	L	Middle of clavicle	3 months	Trauma	Excision of clavicle after recurrence	"Osteosarcoma"	Very good	No recurrence three years later	
77	Delatour	1897	Ibid.	P 20	R	Acromial end	2 months	No trauma	Excision of entire clavicle	Osteosarcoma	Good	Not known	
78	Delatour	1897	Ibid.	M 55	..	Sternal end	3 months	Trauma	Excision of sternal end of clavicle plus piece of sternum and of first rib	Sarcoma	Complete use of arm	4 mos. later fracture of base of skull	No evidence of return of tumor
79	Vaughan	1898	Med. News, Jan. 8, 1898	M 28	R	Inner two-thirds of clavicle	7 months	Large hard tumor	Removal of entire right clavicle with tumor	Mixed-celled round and spindle	Excellent	Perfectly well 18 yrs. later	Personal report from Doctor Vaughan
80	McBurney	1898	Annals of Surgery, Vol. xxviii, p. 259	M 37	L	Sternal end	18 months	.....	Total excision	Osteosarcoma	Almost normal	Not known	Further history not known
81	Curtis	1898	.....	M 37	L	.....	Trauma 9 years ago	Trauma 9 years ago	Total excision	Osteosarcoma	Good	1 year later operation for metastasis in 7th rib of left side	
82	Beatson	1902	Brit. Med. Jour., 1902, I, p. 129	F 16	..	Sternal end	7 months	No trauma	Total excision	Angioma	Almost normal	No recurrence 2 yrs. later	
83	Smith	1902	Brit. Med. Jour., 1902, I, p. 720	M 35	R	Sternal end	5 months	Trauma	Total excision	Chondrosarcoma	Good, little deformity	Free from recurrence when last seen, 13 mos. after operation	
84	Carson	1904	Am. Pract. of Surg., Vol. vi, p. 420	F 18	R	Sternal end	6 months	No trauma	Total excision	Sarcoma	.....	Not known	
85	Vogel	1908	Med. Klinik, 1908, I, p. 286	M 27	R	Outer half	2 months	Trauma 7 mos. before; size half of hen's egg	Resection of outer two-thirds bone transplanted from tibia	Round-celled sarcoma	Good	Well 2 yrs. later, no recurrence	Transplanted bone was soon pushed off

TABLE OF REPORTED CASES OF SARCOMA OF CLAVICLE—Continued.

No.	Reporter	Date	Reference	Age Sex	Side	Site	Duration	Description	Operation	Type	Result	Final result	Remarks
86	Jordan	1908	Deutsche med. Wochenschr., 1908, I, p. 175	F 8	L	.....	.....	.....	Total excision of left clavicle, piece of scapula and 1st rib	Round-celled sarcoma	Good	Well and free from recurrence 7 mos. later	
87	Roith	1908	Deutsche med. Wochenschr., 1908, I, p. 175	F 17	..	Medial portion	.....	Size of goose egg	Total excision	Cysto-sarcoma	Good		
88	Piperata	1909	Deutsche Zeitschrift f. Chir., 1909	M 74	L	Sternal portion	3 months	.....	Resection of sternal end	Chondrosarcoma	.....	Death after 3 years	Cause not stated
89	Piperata	1909	Bd. 102, p. 195	M 19	L	.....	7 months	.....	Resection of left clavicle with tumor	Spindle-celled sarcoma	.....	Death within a few mos.	Partly local recurrence, partly metastases
90	Piperata	1909	Ibid.	F 23	..	.....	5 months	Inoperable	No operation	Sarcoma	.....	Died within 10 months	
91	Ganduchean et Masson	1909	Bull. et Mém. Soc. Anat. de Paris, 1909, p. 61	M 54	..	Middle portion	6 months	No trauma—size of walnut	Type of operation not stated	Periosteal round-celled sarcoma	Not stated	Not stated	
92	Patel	1910	Lyons Med., 1910, p. 715	M 24	L	Middle portion of left clavicle	3 months	Size of hen's egg	Total excision	Sarcoma osteoides	Excellent, hardly noticeable defect	Not stated	Wassermana positive Hg. j. R. treatment; tumor increased in size steadily
93	Wilson	1911	Lancet, 1911, I, p. 1422	F 11	..	Inner half	.....	No trauma	Resection of inner half	Sarcoma probably periosteal mixed	Good	Free from recurrence 7 mos. later	
94	Schmidt	1906	(Ref. Annual Rep.)	P 57	..	.....	.....	Grown into deltoid muscle, thyroid structure	Excision of clavicle	Tumor of thyroidal structure	Good result	.....	Thyroid not enlarged
95	Halperine	1908	(Ref. Guilbe)	M 54	..	Outer end	20 years then trauma	More rapid growth after trauma; size of fist	Total excision	Thyroidal structure; struma present	.....	.....	Grew rapidly after trauma

# SARCOMA OF THE CLAVICLE

96	Gaibé	1909	Bull. et Mém. Soc. Chir. de Paris, 1909, p. 117	P 51 R	Outer third	.....	No trauma pulsating tumor, size of a hen's egg. No glands struma and metastases	Exarticulation of inner and then outer half	Glandular tissue thyroidal structure	Very good	No recurrence a little over a year later	Thyroid gland atrophic
97	Jaboulay	1909	(Ref. Annual Rep., 1909)	M 60	.....	.....	Struma metastases	Extirpation of clavicle; 2 weeks later partial removal of struma	Struma, metastases in clavicle. Spontaneous fracture of bone	Good	Not known	
98	Sehard and le Clerc.	1883	Rev. de Chir., 1883, Vol. 3, p. 613	F 62 R	Sternal end	6 months	No trauma, size of hen's egg; pulsating	Total excision	Malignant tumor cystic epithelioma	.....	No recurrence, abs. 10 months later	
99	d'Estar and Masabian	1908	Rev. de Chir., 1908, Vol. 39, p. 343	F 50	Outer two-thirds	.....	.....	Almost total resection	Lymphoma	Survived operation	.....	Author expects very little benefit from operation
100	A. F. Bock	1894	St. Louis Med. Jour., 1894, p. 347	M 55 R	Sternal end	3 months	No trauma, pain severe	Removal of tumor large size	Large round-celled sarcoma	Excellent recovery	2 wks. observation O. K.	6 mos. before amputation of arm at shoulder joint for osteosarcoma
101	A. T. Bristow	1898	Bryn. Med. Jour., 1898, p. 306	M 22 L	Lower border	2-3 weeks	Painful, size of duck's egg	Removal of clavicle	Fascial sarcoma later, osteosarcoma mixed, small round-cells, no spindle cells	Good	Recent observation	Also a tumor in lumbar region found—to be operated on later, present since childhood
102	Jas. Thorburn	1883	Canadian Practitioner	M 43 R	Above sternal half	9 weeks	Trauma carried holes size of orange	Removal of tumor	Spindle-celled sarcoma, some round-cells	Good functional result	Complete disappearance	Well 5 years
103	Küttner	1909	Allg. Med. Centralztg., p. 198	.....	Sternal end	.....	Size of fat, spontaneous fracture	Exarticulation sternoclavicular joint	Spindle-celled sarcoma	Good functional result	Complete disappearance	Well 5 years
104	Ibid.	Ibid.	Ibid.	.....	Ibid.	.....	Size of hen's egg	Total excision	Osteochondro mixed sarcoma	Good functional result	Complete disappearance	Well 5 years
105	Pinch	.....	Personal communication	P 62 R	.....	4 months	10 x 6 x 2 cm.	Inoperable except by Beiger shoulder joint amputation refused	Round-celled sarcoma	Treated by radium only	Complete disappearance	Well 5 years

WILLIAM B. COLEY

PERSONAL CASES OBSERVED BY THE WRITER SINCE THE TIME OF HIS LAST REPORT IN 1910.

No.	Name	Year	Sex	Site	Duration	Trauma and other data	Operation or treatment	Type	Result functional	Final result	Remarks		
1	B. F.	1918	M	49	R	Sternal half	8 weeks	Strain of shoulder, pathologic fracture	Exploratory by other surgeon. Later toxin and radium treatment	Large round-celled sarcoma	Temporary improvement only	Death in 6 mos.	Borderline case as regards operability
2	C. A.	1918	M	57	R	Inner two-thirds	1 1/4 year	Strain of shoulder	Considered inoperable; toxins and radium (Coley)	.....	Temporary improvement only	Death, March 27, 1919, a year and 5 months after the injury	Borderline case
3	T. M.	1912	M	12	R	Inner half	5 weeks	Trauma; size of hen's egg	Total excision, recurrence; then toxins 2 months	Periosteal small round-celled sarcoma	Recurrence after 10 days	Temporary improvement; death 5 mos. after first noticed	
4	S. L.	1919	F	12	R	Sternal portion	1 month	Size of hen's egg	Radium	Periosteal	Local improvement, but generalization of disease	Death within 6 months from time tumor was first noticed	This case was operable when seen, but it was decided to use radium treatment alone

## SARCOMA OF THE CLAVICLE

give radium treatment or toxin treatment, or a combination of both, before excision, or, shall we excise the clavicle and use the treatment, singly or combined, after operation as a prophylactic against recurrence? I have never used the toxins in operable cases of sarcoma except in such cases where operation meant the sacrifice of the limb. In sarcoma of the clavicle, the loss of the clavicle cannot in any sense be regarded as analogous to the loss of a limb. The single brilliant success of Pinch, in which no operation was performed, is offset by the Memorial Hospital case, in which radium was tried in preference to operation, with rapid generalization of the disease and a disastrous end result. Personally, I would strongly hesitate to use radium alone, or with toxins, in any operable case of sarcoma of the clavicle, for fear that early metastases of the lungs might develop while watching the usual rapid and remarkable local disappearance of the tumor. If the clavicle were of great importance to the patient, like one of the bones of the arm or leg, I would take the chance of trying to save it by the use of toxins and radium before operating; but, our own results as well as those that have been reported by other men, show that the functional use of the arm is practically normal after total excision of the clavicle and the deformity is so slight as hardly to be regarded.

In 87 cases of sarcoma of the clavicle in which the sex was noted, 49 occurred in the male, and 38 in the female, the greater number in the male being probably accounted for by the fact that the male is much more exposed to injury than the female.

As regards the age of the patient at the time the sarcoma was first noticed, our statistics show that by far the greatest proportion occurred in youth or early adult life, *e.g.*: 1 at birth; 5 between the ages of one and ten years; 29 between the ages of eleven and twenty years; 17 between the ages of twenty-one and thirty years; 16 between the ages of thirty-one and forty years; 12 between the ages of forty-one and fifty years; 10 between the ages of fifty-one and sixty years; 6 between the ages of sixty-one and seventy years; 1 over the age of seventy years.

As regards the site, as far as known 39 occurred on the right side and 33 on the left; in 41 cases at the sternal end, 16 at the middle, 18 at the outer, and in 1 case both clavicles were involved.

Regarding the duration of the disease, our statistics show in 9 cases less than one month; 2 cases less than one month; 4 cases less than two months; 9 cases less than three months; 1 case less than four months; 3 cases less than five months; 7 cases less than six months; 6 cases less than seven months; 2 cases less than nine months; 4 cases less than one year; 2 cases less than one year and two months; 2 cases less than one year and six months; 7 cases less than two years; 1 case less than four years; 1 case less than five years; 1 case less than seven years; 1 case less than nine years; 1 case less than twenty years.

My own series of cases show a definite history of trauma in 12; no trauma in 3; and not stated in 3 cases.



In the total number of tabulated cases, 108, the disease was too far advanced for operation at the time of observation in 10 cases; and in 56 cases total excision, or practically total excision, was performed.

It is worthy of note that only 5 patients out of 80 treated by total or partial excision of the clavicle are known to have remained well beyond four years. While 3 out of 4 patients treated by the mixed toxins of erysipelas and *B. prodigiosus* as a prophylactic after total excision are alive and well from six to twelve years.

#### CONCLUSIONS

1. Malignant tumors of the clavicle are comparatively rare, only 16 cases having occurred in upwards of 275 cases of sarcoma of the long bones personally observed. The greatest number belong to the sarcoma group, the few cases of carcinoma being metastatic developments from some recognized or unrecognized primary focus.

2. Sarcoma of the clavicle occurs more frequently in men than in women, probably due to the fact of the greater liability of the clavicle to injury in the male than in the female.

3. Sarcoma of the clavicle in the great majority of cases is associated with recent, antecedent, local trauma, either in the form of a direct blow or severe muscular strain.

4. *Diagnosis*: A clinical history of pain and localized swelling of the clavicle usually following recent injury, with rapid increase in size, supplemented by a fairly characteristic X-ray picture, will usually make an early diagnosis comparatively easy without the necessity of an exploratory operation.

5. *Treatment*: Local removal of the tumor or even a limited, partial resection should be avoided. The treatment of choice, while the tumor is in an operable stage, should be:

- a. Total excision of the clavicle as soon as the diagnosis is made.
- b. As soon as possible after operation, a course of systemic treatment with the mixed toxins of erysipelas and bacillus prodigiosus should be begun and continued for a period of at least six months. When possible this should be supplemented with local or regional treatment with radium or X-rays.

6. The mortality of total excision of the clavicle under modern technic is so small as to be practically disregarded and the functional use of the arm remains unimpaired.

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